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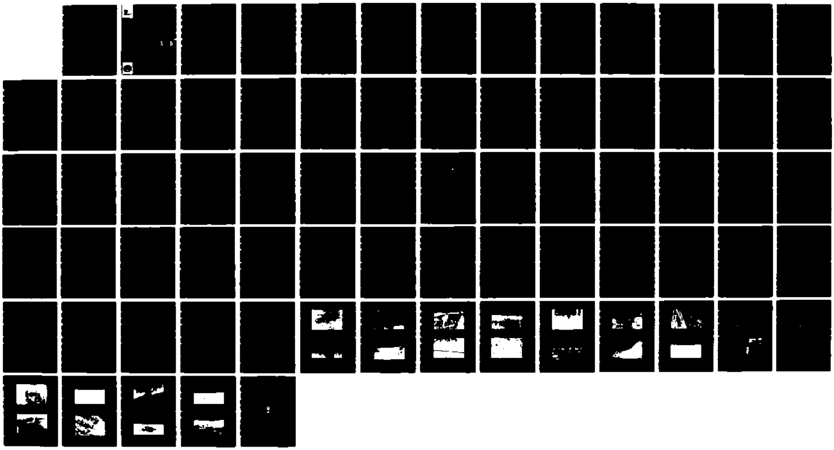

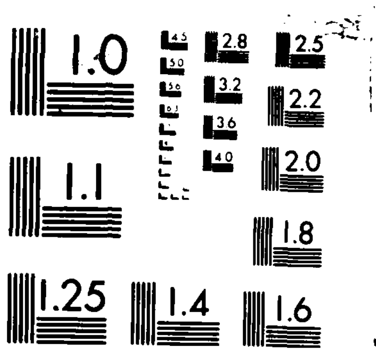

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WETLANDS INVESTIGATIONS ON AKERS RANCH IN BIG VALLEY, CALIFORNIA

by

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R. F. Theriot, P. H. Jones

Environmental Laboratory

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US ARMY ENGINEER WATERWAYS EXPERIMENT STATION

December 1986
Final Report

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ENVIRONMENTAL LABORATORY

The D-series of reports includes publications of the
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This study, conducted for the US Army Engineer District, Sacramento (SPK), involved delineation and evaluation of wetlands, a survey of previous farming activities, and assessment of impacts of a proposed land development plan on the Robert W. Akers ranch in northeastern California. Results of the study were used by SPK to support litigation in which the property owner allegedly violated provisions of Section 404 of the Clean Water Act of 1977. (Continued)		

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20. ABSTRACT (Continued).

The first task was to delineate natural wetlands occurring on the 9,600-acre ranch. A combination of transects and perimeter wetland boundary sampling was used. Vegetation, soil, and hydrology parameters were examined at prescribed locations, and the area at a sample point was considered to be a wetland if a positive wetland indicator was found for each of the three parameters. The resulting perimeter wetland boundary was surveyed and mapped, and the wetland acreage was calculated using a map digitizer. Natural wetlands occurred on 2,889 acres of the property. Other portions of the property were found to support wetland vegetation, existing due to a long-standing irrigation practice. However, soils in these areas did not exhibit hydric characteristics, and such areas were not considered to be wetlands. Independent hydrologic analyses of gaging station data closely correlated with the wetland boundary developed from field sampling.

Task II consisted of an assessment of the functions and values of the natural wetlands. Field observations, hydrologic analyses, and published reports were provided as input to the Federal Highway Administration wetlands assessment technique that considers all known wetlands functions. Results indicated that the wetlands on the property rated (a) high for wildlife habitat (especially for waterfowl and other water-dependent birds), shoreline anchoring and sediment trapping, and long-term nutrient retention; (b) moderate for food chain support, ground-water discharge, and flood storage and desynchronization; and (c) low for fisheries habitat, ground-water recharge, and all active recreation functions. Of special significance was use of the wetlands by certain rare and/or endangered species, including the bald eagle, greater sandhill crane, and peregrine falcon. The wetlands are also used as a staging area by the cackling goose (the smallest subspecies of Canada goose), the population of which has greatly reduced in recent years.

Task III involved a survey of previous farming activities on the property. Interviews with a number of local residents revealed that the wetlands have been used only for production of native marsh hay and grazing by cattle. Soil tillage has been restricted to nonwetland portions of the property.

Task IV consisted of an assessment of the impacts of a proposed land development plan. The assessment revealed that the proposed activities would result in the destruction of virtually all wetlands on the property, and all functions currently provided by the wetlands would be lost.

PREFACE

This report documents wetlands investigations conducted by personnel of the US Army Engineer Waterways Experiment Station (WES) on the Robert W. Akers property near Bieber in northeastern California. The work was conducted for the US Army Engineer District, Sacramento (SPK), under auspices of the Dredging Operations Technical Support Program (DOTS). Funding for the project was provided by both SPK and DOTS. The DOTS Program is funded by the Office, Chief of Engineers, US Army, through the Dredging Division of the Water Resources Support Center, Fort Belvoir, Va. Implementation of DOTS was assigned to the WES Environmental Laboratory (EL). DOTS is managed through the EL Environmental Effects of Dredging Program (EEDP), Dr. Robert E. Engler, Manager, and Mr. Thomas R. Patin, EEDP DOTS Coordinator.

The work consisted of delineation of natural wetlands, determination of past farming activities, assessment of wetlands functions and values, and assessment of impacts of a proposed land development plan on the wetlands. Several lengthy appendixes produced to accompany the report are listed in the Contents and cited in the report but are not included in the published report. These appendixes can be obtained from the authors on request.

The report was prepared by Dr. Dana R. Sanders, Sr., and Messrs. Ellis J. Clairain, Jr., Russell F. Theriot, and Phillip H. Jones, all of the Wetlands and Terrestrial Habitat Group (WTHG), Environmental Resources Division (ERD), EL, WES. Mr. Jones was a US Department of Agriculture Soil Conservation Service (SCS) employee on detail to WES. Others assisting in the collection of field data included Mr. William B. Parker, US Department of the Interior, Fish and Wildlife Service, National Wetlands Inventory, St. Petersburg, Fla.; Mr. Charles Ferrari, SCS, Burney, Calif.; Dr. Michael Baad, University of California-Sacramento, Sacramento, Calif.; and Mr. Peter Waller, SPK. Mr. Ray Webb led the field party that surveyed transects and the wetlands boundary. Logistical assistance was provided by Messrs. Jim Gibson and Thomas Coe of SPK. The report was edited by Ms. Jessica S. Ruff of the WES Information Products Division. The project was conducted under the technical supervision of Dr. Sanders; under the direct supervision of Dr. Hanley K. Smith, Chief, WTHG; and under the general supervision of Dr. Conrad J. Kirby, Jr., Chief, ERD, and Dr. John Harrison, Chief, EL.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

This report should be cited as follows:

Sanders, D. R., Sr., et al. 1986. "Wetlands Investigations on Akers Ranch in Big Valley, California," Miscellaneous Paper D-86-7, US Army Engineer Waterways Station, Vicksburg, Miss.

CONTENTS

* Appendixes A-D are available from the authors upon request.

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CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
acres	4,046.873	square metres
cubic feet per second	0.02831685	cubic metres per second
feet	0.3048	metres
inches	25.4	millimetres
miles (US statute)	1.609347	kilometres
pounds (mass)	0.4535924	kilograms
tons (2,000 pounds, mass)	907.1847	kilograms
yards	0.9144	metres

WETLANDS INVESTIGATIONS ON AKERS RANCH IN BIG VALLEY, CALIFORNIA

PART I: INTRODUCTION

Background

1. On 1 May 1984, the US Army Engineer District, Sacramento (SPK), asked the US Army Engineer Waterways Experiment Station (WES), Vicksburg, Miss., for assistance* in delineating and evaluating wetlands on approximately 9,600 acres** owned by Mr. Robert W. Akers near Bieber in Big Valley, Calif. (Figure 1). The property in question is located on Ash Creek, near its confluence with the Pit River (Township (T)38N-T39N, Range (R)7E-R8E). The SPK asked for WES assistance in separating portions of the property that are uplands or irrigated lands from wetlands that may be subject to Corps of Engineers (CE) jurisdiction under Section 404 of the Clean Water Act (CWA) of 1977 (US Code 1977).

2. A portion of the 9,600 acres has been utilized for agricultural purposes since about 1900. After peak spring runoff, flow from Ash Creek historically has been diverted into various channels to distribute water throughout the property. Diverted water was used to increase the growth of various native plant species, which were then harvested as hay. Portions of the property were also used as grazing land. A basic issue in this case focused on whether the typical pattern of water diversion fostered development of wetlands on portions of the property that were nonwetlands prior to initiation of irrigation practices. A second issue centered on functions of the natural wetlands and their values. This information is critical to assessment of environmental impacts of the proposed project on the natural wetlands. To better understand and interpret results obtained in this study, it was also deemed necessary to determine the type, scope, and location of agricultural activities that had been conducted previously on the property.

3. Mr. Akers has proposed to develop an irrigation system that will

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* Assistance requested through the Dredging Operations Technical Support (DOTS) Program, Environmental Laboratory, WES.

** A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 5.

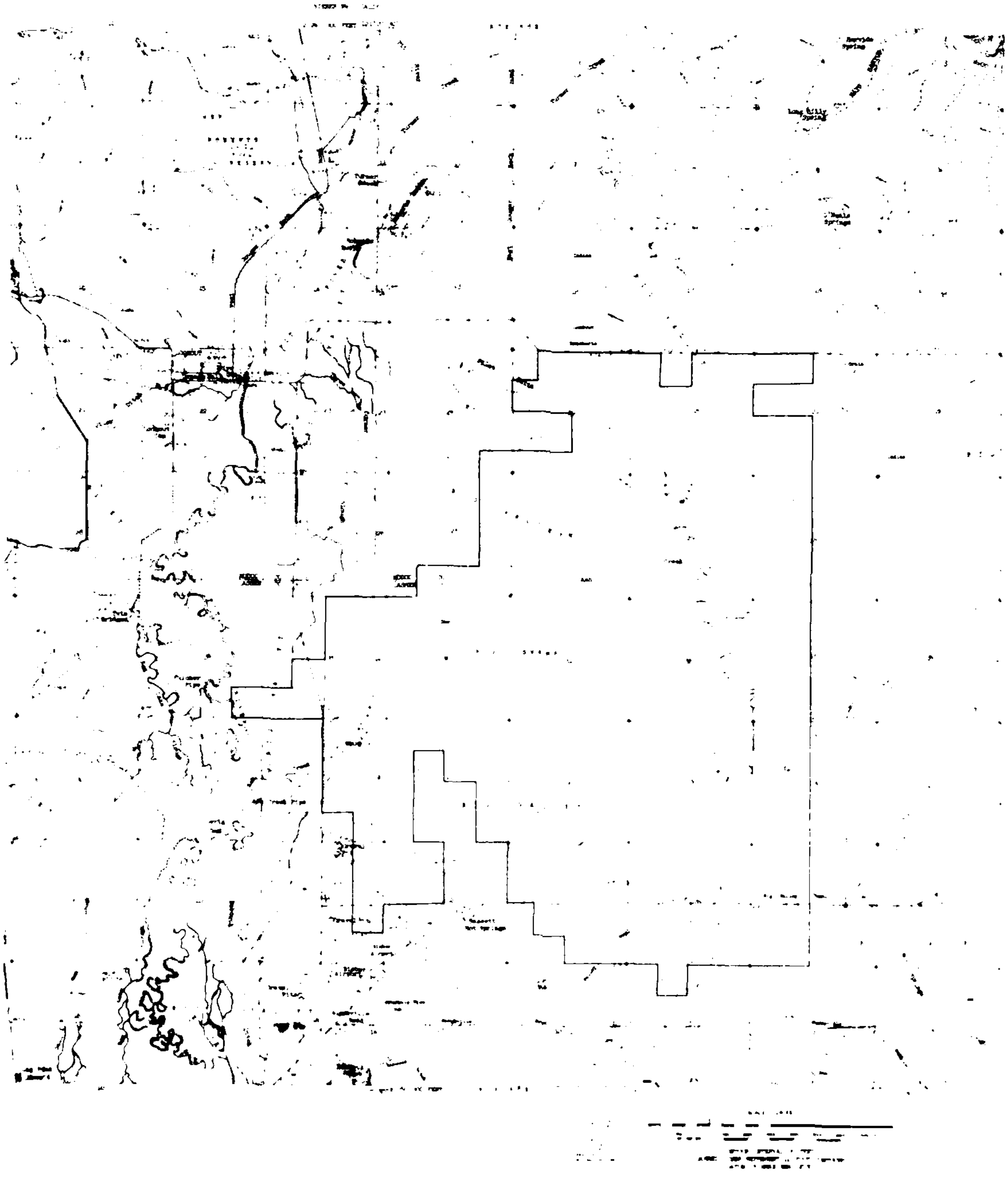

Figure 1. Map showing boundary of Akers Ranch

encompass virtually the entire property (US Army Engineer District, Sacramento 1984). He proposes to construct a large north-south collecting canal across the eastern side of the property. Lateral canals extending in a westerly direction from the collecting canal would be constructed to distribute water across the property as needed. A reservoir constructed in the northeast corner of the property and eight large wells would be used to provide irrigation water during periods of low flow. Existing channels and ditches would be filled. The property would then be tilled and used for production of upland crops (e.g. alfalta and barley).

4. The Environmental Laboratory, WES, agreed to provide the requested assistance, and onsite investigations were conducted 11-19 June 1984. The SPK obtained written approval for right-of-entry from Mr. Akers and his representative, Mr. Lanny Winberry.

Purpose and Scope

5. The purpose of this report was to provide SPK with a summary of onsite field investigations, including methods employed, results obtained, and conclusions drawn. The report includes only technical conclusions that resulted from each type of investigation. No effort was made to establish the limits of CE Section 404 jurisdiction, the level of wetlands values required to deny a potential permit application, nor the type or level of agricultural activities required to qualify or disqualify an area for an agricultural exemption.

Objectives

6. Specific objectives of this investigation were to:

a. Determine the portion (if any) of the property that constitutes natural wetlands and establish a boundary line that separates any natural wetlands from nonwetlands (irrigated lands and uplands).

b. Gather and synthesize information on past agricultural activities on the property, particularly those occurring in natural wetlands.

c. Conduct an evaluation of natural wetlands occurring on the property.

d. Assess environmental impacts of the proposed project.

PART II: WETLANDS DELINEATION

Rationale and Approach

Rationale

7. The CE has defined wetlands as:

> Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (US Code 1977).

Three parameters are implicit in the definition: hydrology, vegetation, and soil. Thus, wetland areas must:

a. Periodically or permanently be inundated or have saturated soils.

b. Have vegetation consisting of species typically adapted for life in saturated soil conditions.

c. Have soils showing evidence of development under anaerobic conditions that occur during periods of prolonged soil saturation.

Indicators of wetland hydrology, wetland vegetation, and wetland soils are described by Huffman and Sanders (1985), and methods for delineating wetlands are described by Sanders et al. (1985). When wetland indicators of all three parameters are present, the area is considered to be a wetland. When wetland indicators of any of the three parameters are absent, the area is considered to be a nonwetland. In the present case, nonwetland portions of the property would lack wetland indicators of at least one of the three parameters. Portions of the property to which water has been diverted may have indicators of wetland hydrology or wetland vegetation (or both), but would lack indicators of wetland soils. Such areas could be called irrigated lands. Irrigation practices have not occurred for a sufficient period to elicit development of wetland soil characteristics in formerly nonwetland soils.* Thus, portions of the Akers property having wetland indicators of all three parameters were considered to be natural wetlands, and all other portions were considered to be either irrigated lands or nonwetlands. No effort was made to differentiate

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* Personal Communication, 1984, W. Blake Parker, US Department of the Interior, National Wetlands Inventory, St. Petersburg, Fla.

between irrigated lands and nonwetlands, since neither is subject to CE jurisdiction under Section 404.

Approach

8. The approach followed was to first establish the general area and extent to which natural wetlands (if any) occurred on the property. This was accomplished by making wetland determinations at regular intervals across the property along four transects that extended perpendicular to the drainage pattern. Once the presence of natural wetlands was determined, the entire perimeter of the area comprising natural wetlands was traversed, and the wetland-nonwetland boundary was established. In addition, hydrologic data were analyzed to reveal the frequency and duration of inundation and soil saturation of the wetlands area. Results of these analyses were used to determine whether or not the wetlands were connected to navigable waters as defined in CE regulations.

Methods

Preliminary data gathering

9. The following information and materials were obtained prior to the onsite investigations:

- a. US Geological Survey (USGS) quadrangle map - Bieber quadrangle (1:62,500), 1961.
- b. Color aerial photomosaic, flown on 8 May 1978 (provided by SPK).
- c. USGS streamflow data.
  - (1) Ash Creek at Adin, Calif. (1905 to present, 33 years of record).
  - (2) Pit River near Canby, Calif. (1904 to 1982, 53 years of record).
  - (3) Pit River at Lookout Point, Calif. (1959 to 1980, 15 years of record).
  - (4) Pit River at Bieber, Calif. (1904 to 1978, 38 years of record).
- d. Base map showing Akers property boundary (provided by SPK).
- e. Orthoquad map, flown 13 April 1981.
- f. Map showing general boundaries of soil types in the area (provided by the US Department of Agriculture (USDA), Soil Conservation Service (SCS)).
- g. Administrative record (provided by SPK).

h. Map showing proposed project on Akers ranch (provided by SPK).

Survey team

10. The delineation survey team consisted of the following individuals:

Name, Title	Organization	Tasks
Dr. Dana Sanders, Sr., Plant Physiologist	WES Vicksburg, Miss.	Team Leader; determined presence of field hydrologic indicators; recorded data; made wetland determinations.
Mr. Russell Theriot, Biologist	WES Vicksburg, Miss.	Established transects and observation points.
Mr. Ellis Clairain, Jr., Aquatic Biologist	WES Vicksburg, Miss.	Established transects and observation points.
Mr. Blake Parker, Soil Scientist	US Fish and Wildlife Service (USFWS), National Wetlands Inventory, St. Petersburg, Fla.	Made determination of presence of wetland soils.
Mr. Charles Ferrari, Soil Scientist	USDA SCS, Burney Field Office Burney, Calif.	Described soil profiles.
Dr. Michael Baad, Plant Taxonomist	University of California-Sacramento, Sacramento, Calif.	Identified plant species and estimated percent cover.
Mr. Phillip Jones, Hydraulic Engineer	WES Vicksburg, Miss.	Obtained and analyzed hydrologic data.
Mr. Peter Waller, Hydrologist	SPK Sacramento, Calif.	Obtained and analyzed hydrologic data.
Mr. Ray Webb, Surveyor	SPK Sacramento, Calif.	Surveyed all observation points.

In addition, Messrs. Jim Gibson and Tom Coe of the SPK provided logistical support during 10-14 June 1984.

Transect sampling

11. Four transects were established perpendicular to the Ash Creek drainage pattern. Transects were approximately 1 mile apart (Figure 2) and were labeled I-IV, beginning with the transect located nearest the Bieber-Lookout Road. Descriptions of transect locations are as follows:

a. Transect I started approximately 100 yd northeast of a field barn located in the southwest corner of Section 1, T38N, R7E. Access was obtained from a field road off the cinder road linking the Bieber-Lookout Road to California Highway 299.

b. Transect II started approximately 50 yd west of a field barn located in the southwest corner of Section 6, T38N, R8E. This transect was almost on the range line (R7E-R8E).

c. Transect III started in a field in the northwest corner of Section 8, T38N, R8E. Access was gained by a field road off California Highway 299.

d. Transect IV started approximately 250 yd west of a field barn located in the extreme southern portion of Section 33, T38N, R8E. Initially, the transect was extended north for a distance of 7,000 ft. Later, the transect was extended to the south to Big Valley Canal for a distance of 7,964 ft.

12. The starting point of each transect was used as the first observation point (Photo 1). Additional observation points were established at 1,000-ft intervals along each transect and were marked by orange surveyor flags (Photo 2). The first and last observation points along each transect were located in nonwetlands (Photo 3). Each transect line was traversed beyond the last observation point to ensure that the transect line crossed no more wetlands.

13. At each observation point, the following data were collected:

a. Vegetation. Each observation point was photographed prior to data collection. Slides of each were provided to SPK. A 6-ft-radius circle was established around the observation point, and all plant species occurring within the sample plot were recorded on the data form (Figure 3). Percent cover was estimated for each species that had at least 10 percent cover in the plot (Photo 4). The National Wetlands Inventory (NWI) indicator status (Table 1) (Reed 1981) was recorded for each species for which percent cover had been recorded. Plant species having an indicator status of OBLIGATE HYDROPHYTE, FACULTATIVE WETLAND, or FACULTATIVE were lumped into one group, and species having an indicator status of FACULTATIVE UPLAND or UPLAND were lumped into another group. When more than 50 percent of the recorded plant cover consisted of the former group, a determination was made that vegetation that could occur in wetlands was present in the plot. Voucher specimens of each species were

Figure 2. Approximate locations of transects sampled on Akers Ranch

WETLAND DETERMINATION

Location: ________________. Legal Description: Township _____ Range ____.

Plot No.: ______________. Elevation: ____________. Date: ______________.

Vegetation (list additional species on back): % of plot vegetated: _______.

Species	% Cover	Indicator Status
1.		
2.		
3.		
4.		
5.		
6.		

% cover of upland species: ______________; of wetland species: ____________.

Wetland vegetation: _____Yes; _____No.

Soils

Series: _________________. Texture (at 26 cm): _________________________.

Mottles: ____ Yes; ____ No. Color of mottles: ____________________________.

Gleying: ____ Yes; ____ No. Series on hydric soils list: ____ Yes; ____ No.

Color of MATRIX: ____________________. Other indicators: _________________.

Wetland soil: ____ Yes; ____ No.

Hydrology

Inundated: ____ Yes; ____ No. Depth of standing water: ____________________.

Saturated soils: ____ Yes; ____ No. Method used: ___________________________.

Other indicators: ____.

Wetland hydrology: _____ Yes; _____ No.

Wetland determination: ____ Yes; _____ No.

Characterization Team:

Vegetation: ____________________________

Soils: ____________________________

Hydrology: ____________________________

Determination By: _______________________

Figure 3. Data form used for wetland determinations on the Akers property

collected and stored in the Department of Biological Sciences, University of California-Sacramento, Sacramento, Calif.

b. Soils. At each observation point, a hole was dug with a spade or auger (Photo 5). A complete soil profile description was made the first time a particular soil type was encountered. In addition, the texture and color of the soil matrix (Munsell Color 1975) at the 10- to 12-in. depth were recorded (Photo 6). The presence of gleying and mottling of the soil was also recorded, and mottle color was determined. Other indicators (e.g. organic layers, concretions) were also recorded. Since the area soils had not been previously classified, soil series were unavailable, and the hydric soil list could not be used. When an indicator of wetland soils was found, a determination was made that wetland soils were present at the observation point.

c. Hydrology. Indicators of wetland hydrology were sought in the following sequence:

(1) Inundation. When free water that could not be attributed to recent local rainfall was present above the soil surface (Photo 7), it was not necessary to look for other hydrologic indicators. Water depth was recorded.

(2) Saturated soils. The soil was determined to be saturated when:

(a) Water filled the hole dug for soil characterization to within 12 in. of the surface.

(b) Water could be squeezed from soil taken from a depth of 10 to 12 in. below the surface.

(c) Surfaces of soil peds within 12 in. of the surface glistened.

(3) Encrusted detritus. In some areas, plant fragments had been cemented together by drying algae and sediments, leaving a crust of detritus on or slightly above the soil surface (Photo 8).

(4) Sediment deposits on plants. Fine deposits of sediments were sometimes observed on plants and detritus.

When any of the above indicators were found, the area at the observation point was considered to have wetland hydrology.

d. Wetland determination. When indicators of all three parameters were present, the area at the observation point was determined to be a wetland. When indicators of any one of the three parameters were absent, the area at the observation point was determined to be a nonwetland.

Determination of wetland boundary along transects

14. When data from successive observation points revealed a change from wetland to nonwetland (or vice versa), the distance between the two

observation points was traversed, and the point where the change occurred was established by using the same procedure described in paragraph 13. Obvious changes in vegetation and/or topography usually provided a clue as to the approximate location of the change. The point of occurrence of each change was marked by a yellow surveyor's flag (Photo 9), and the corresponding data sheet was numbered from the previous regular observation point (i.e., if the boundary occurred between plots 3 and 4, the data sheet was numbered 3a). The distance of the wetland boundary from the transect starting point was recorded.

Delineation of the
perimeter wetland boundary

15. After all transects had been sampled, the wetland boundary around the entire property was determined. Wetland boundaries along transects were used as reference points, and the wetland boundary between transects was determined. The procedure described in paragraph 13 was applied at each point (300- to 500-ft intervals), and a surveyor's flag was placed at each point. A data sheet was completed for each point. In some areas, wetlands and nonwetlands formed a mosaic pattern. When more than one-half of these areas consisted of wetlands, the entire area was included as wetlands. When more than one-half of the area consisted of nonwetlands, the entire area was excluded as wetlands. Flags representing wetland-nonwetland boundaries were always placed on the wetland side of the boundary.

Surveying

16. Each transect and flag was surveyed by SPK personnel. Both horizontal and vertical control were obtained for each point along the transects, and also for points delimiting the perimeter wetland boundary. In addition, elevations were determined at 200-ft intervals along the transects.

Examination of comparable area

17. An area in Ash Creek Valley (T38N, R11E, Section 32) was examined to determine whether wetland types found on the Akers property also occurred in unirrigated areas. Vegetation, soil, and hydrology were characterized for each wetland type using the procedure described in paragraph 13.

Synthesis of data

18. Vegetation. A list of plant species observed on the property was generated. Plant names were annotated to conform to the USDA-SCS National List of Scientific Plant Names (US Department of Agriculture, Soil Conservation Service 1982). Plant names originally recorded on the data forms were

changed accordingly. *The NWI indicator status of each dominant species was* checked for accuracy, as was the total percent cover of wetland and nonwetland plant species found at each observation point.

19. Soils. Soils encountered on the property were classified, and their descriptions were sent to the State SCS office for determination of the soil series.

20. Field hydrology. No synthesis was necessary.

21. Wetland acreage. The surveyor plotted the location of each observation point (both along transects and the perimeter sampling), and the resulting map (scale: 1 in. = 500 ft) was digitized to determine the wetland acreage.

Analysis of existing hydrologic data

22. The area was investigated to determine the hydrologic characteristics (e.g. frequency, timing, duration, and magnitude of inundation) on the Akers property, as well as the influencing upstream drainage basins. Available literature pertaining to the area and interviews with knowledgeable persons were used as a historical basis for determining irrigation practices normally applied on the property. Flow durations were obtained from analysis of stream gage data (Sanders et al. 1985), and a range of discharge capacities (rating curves) was determined for channel flow and overland flow for typical sections along the lower portion of Ash Creek, the Big Swamp* area, and the Pit River adjacent to the Big Swamp, using a water surface profile computer program (WSP2). The inundated area was determined for the range of discharges used. These discharge capacities were computed for both with and without the commonly practiced irrigation schemes. The average growing season length (125 days, 1 May-2 September) was based on US Weather Service data,** field observations, and discussions with local residents. Analyses of soil saturation were included by using a soil permeability coefficient of 0.2 in./hr for saturation and 0.05 in./hr for desaturation and computing the additional time soils of dewatered areas remained saturated within 10 in. of the surface. From these data, the frequency and duration of inundation and/or soil saturation at the wetland boundary were calculated for both with and without

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* Although commonly called Big Swamp, the area is actually a marsh because only herbaceous vegetation is present. Swamps are vegetated by woody species.

** Data obtained from US Forest Service Ranger Station, Adin, Calif.

irrigation, for both seasonal and annual events.

Results

Wetland acreage

23. The natural wetlands portion (Figure 4) of the Akers property included 2,889 acres. Original field data sheets used to establish the wetland boundary are provided in Appendix A. The actual acreage of wetlands is thought to be greater because wetlands apparently also occur west of the Bieber-Lookout Road, south of California Highway 299, and east of Transect IV (Figure 2). However, no attempt was made to delineate wetlands in these areas because they were generally outside the proposed project area.

Community types

24. Several community types* occurred on the property, as follows:

a. Upland. The surrounding hills were dominated by *Artemisia tridentata* (Photo 10). These areas showed no evidence of inundation, and soils had a chroma** of greater than two.

b. Farm fields. Most transects started and ended in farm fields (Photo 11). They began on high ground (low hills and/or ridges) and were usually dominated by upland grasses (e.g. *Poa bulbosa, Bromus mollis, Festuca megalura, Hordeum stebbensii*, and *Bromus rigidus*), various broadleaf weedy species (e.g. *Convolvulus arvensis, Cardaria draba*, and *Matricaria matricarioides*), and some agronomic species (e.g. *Medicago minima*). *Medicago sativa* (alfalfa) was rarely observed on the property, and only at elevations above the wetland boundary. These areas showed no evidence of inundation, and soils had a chroma of greater than two.

c. Irrigated lands. Large portions of the property consisted of species commonly found in farm fields, but with some wetland species interspersed (sometimes as dominants). Wetland species usually consisted of either *Juncus effusus* or *Carex nebrascensis*. These areas showed evidence of recent inundation or were presently inundated (Photo 12), but the soils were nonhydric.

d. Wetlands. Three distinctive wetland types were present, including (wettest to driest):

(1) Tule marsh. The lowest areas were dominated by *Scirpus acutus* (tule), *Typha latifolia*, and *Juncus effusus*, with

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* A list of plant species observed on the property is provided in Appendix B.

** Chroma is a component of color that indicates strength or departure from a neutral of the same lightness. Soils having a matrix chroma of less than two were considered to be wetland soils.

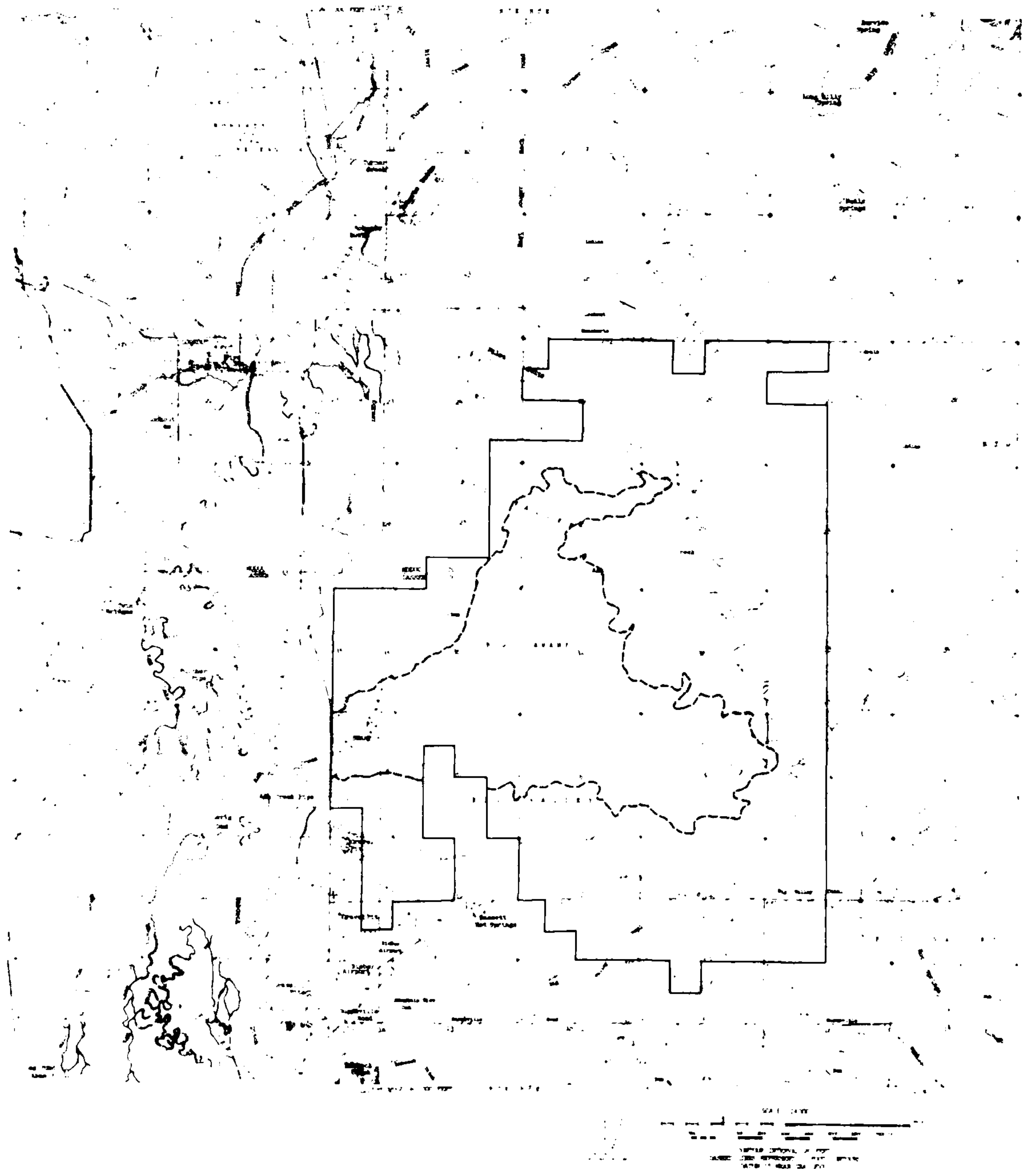

Figure 4. Map showing boundary (dashed line) of natural wetlands on the Akers property

various aquatic species (e.g. *Hippuris vulgaris, Sagittaria cuneata, Ranunculus aquatilis*, and *Utricularia vulgaris*) also present (Photo 13). Deeper portions of this area had 1 ft of standing water, and all of the tule marsh was inundated. Soils were very dark (high organic matter), highly reduced, and had a chroma of zero or rarely one (Photo 6).

(2) Sedge-rush marsh. An extensive wetland type (Photo 14), consisting of *Juncus effusus, Carex nebrascensis, Carex praegracilis, Alopecurus geniculatus*, and various broadleaf wetland species, bordered the tule marsh. This wetland type was presently inundated by 1 to 4 in. of standing water in some areas, while other areas were uninundated but usually had saturated soils. Rarely, the soils were not saturated, but other hydrologic indicators were present. Soils ranged from black with a chroma of zero, to dark brown with a chroma of less than two.

(3) Seasonal wetlands. A small area in the southwestern portion of the property (between Transect I and the Bieber to Lookout Road) consisted of wetland vegetation that dominates the site during spring and early summer, but becomes dormant during mid- to late-summer (Photo 15). Species commonly occurring as dominants were *Plagiobothrys stipitatus, Psilocarphus brevissimus, Navarettia leucocephala, Orthocarpus campestris*, and *Downingia laeta*. The area was not presently inundated, but encrusted detritus and sediments on plants were commonly observed. Soils were very dark, usually having a chroma of zero.

(4) Stream channels. Numerous stream channels were encountered (Photo 16). Some contained standing or flowing water, while others were dry. Watered channels usually contained submersed or emergent aquatic species (e.g. *Myriophyllum exalbescens, Elodea canadensis, Ranunculus aquatilis*, and *Hippuris vulgaris*). Dry channels were often unvegetated, or were sparsely vegetated by wetland species such as *Polygonum amphibium* var. *stipulaceum, Ludwigia palustris* var. *americana, Plagiobothrys mollis*, and *Downingia elegans*.

Comparable unirrigated area

25. The comparable unirrigated area examined in upper Ash Creek Valley consisted of two wetland types: (a) tule marsh and (b) sedge-rush marsh. The tule marsh was monotypic and dense (Photo 17). Water depth was 13 in. Soils were dark brown with a chroma of one, and had 3 in. of organic matter at the surface. The sedge-rush marsh was dominated by *Juncus effusus, Carex praegracilis, Carex nebrascensis*, and *Eleocharis palustris* (Photo 18). This area was inundated to a depth of 6 in. (maximum). Soils were dark brown with a chroma of one, and 5 in. of organic matter occurred at the soil surface.

Existing hydrologic data

26. Onsite investigations and review of topographic data showed that the major source of inundation on the western portion of the property (Figure 2) was from the Pit River. Analysis of stream gaging stations on the Pit River near Canby, Lookout Point, and Bieber revealed that the Lookout Point gage, which is located nearest to the property, provided a reliable source of flow data for use in this portion of the study area. Statistical analysis of data from this gage followed the most widely accepted procedure for water resources investigations (US Water Resources Council 1981). The 100-year frequency discharge from this analysis is 17,200 cfs. Associating this value with stage versus discharge computations showed a flood depth in the western portion of the property (vicinity of Transect 1) to be approximately 4.5 ft. Analysis of data from Ash Creek at Adin was used as a basis for frequency determinations in the eastern portion of the property. Observing flood depths in an easterly direction (upstream) from the confluence of Ash Creek with Pit River showed that the western portion of the property is in the transitional area of flood influence between Pit River and Ash Creek (Figure 5).

27. Analysis of growing season hydrologic data showed that the perimeter of the wetlands boundary determined using the three-parameter field investigation is inundated or has saturated soils on average for 5 percent of the growing season. Duration of inundation or soil saturation in lower portions of the property exceeds 75 percent of the growing season. Summaries of these data are presented for each transect (Table 2), based on stream gage data from Pit River (Lookout) and Ash Creek (Adin).

28. Impacts of the previously applied irrigation practices can most readily be shown by comparing the additional area inundated on average during the growing season, assuming that all the Ash Creek channels are blocked (i.e. all channel flow directed to overland flow). Table 3 shows the increase in stage and area inundated at each transect due to irrigation for a range of flow durations. A total of 788 acres of nonwetlands on the eastern side of the property are inundated at the 5-percent flow duration when all channels are blocked (Table 3). Most water rights for the Akers property are from Ash Creek rather than from the Pit River. Some inundation due to irrigation occurs in the western portion of the property upstream from the Cerig Dam on the Pit River. Much of the water observed on the wetland area during the site visit was influenced by this dam. During the site visit, release of water

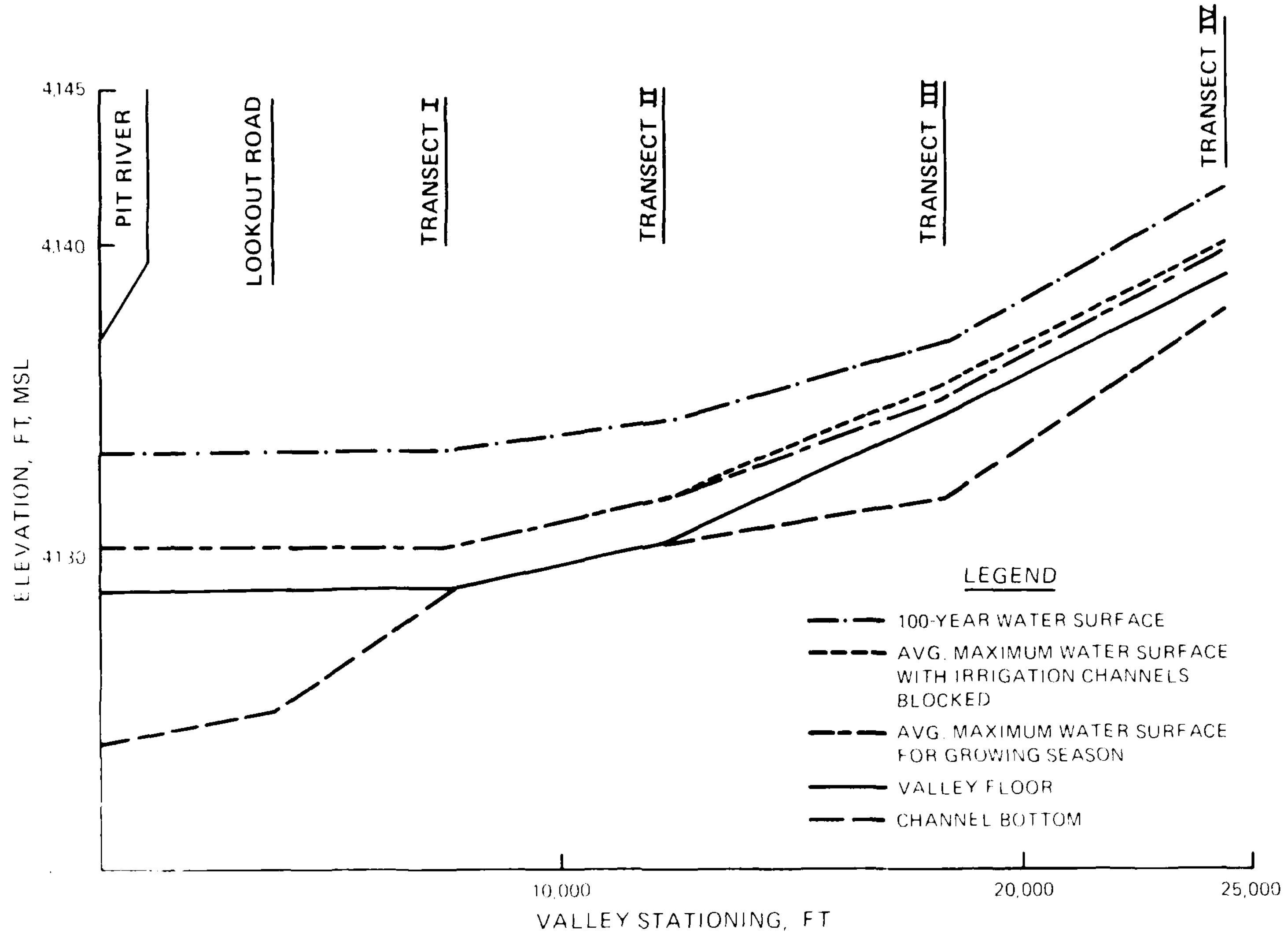

Figure 5. Ash Creek marsh profile through Akers Ranch

from behind this dam caused an approximate reduction of 1.8 ft in the water surface elevation at the Ash Creek bridge on the Bieber-Lookout Road. However, the water level observed in the western end of the wetlands during the field visit was at a lower elevation than the elevation of the wetland boundary. This implies that the existing irrigation practice by the adjacent landowner does not directly influence wetness above the naturally occurring wetland area.

Discussion

29. The 2,889-acre area shown in Figure 4 consists of natural wetlands, not wetlands due to irrigation. Natural wetlands and irrigated lands on the Akers property may have some similar characteristics (both may be inundated at some time and both may have some of the same wetland plant species), but irrigated lands do not have characteristic wetland soils and usually have upland species and wetland species as codominants. All soils having matrix chromas of less than two were wetland soils, and these occurred almost exclusively on and within the area delimited by the wetland boundary. Although water diversion activities have changed the flow patterns, the time interval (since 1900) has been insufficient to cause nonwetland soils to develop characteristics of wetland soils. In addition, the relatively short growing season, confinement of growing season inundation on nonwetland areas largely to the early part of the growing season, and the pattern of water diversion combine to increase the time required to develop hydric soil characteristics. Thus, the portion of the property adjudged wetlands by use of the three-parameter method has historically been wetlands. As evidence to support this conclusion, soils in the wetlands area were identified in 1920 by SCS as mucks (Watson and Cosby 1924). Also, the types of vegetation and soils on the comparative area were very similar to those found in wetlands on the Akers property. Soils in the tule marsh of the comparable area in Ash Creek Valley were not quite as dark as soils on the Akers property, but they were still *bona fide* wetland soils.

30. Analysis of the existing hydrologic data revealed that the wetland portion of the Akers property becomes periodically inundated during the growing season by overflow from the Pit River and from Ash Creek. Diversion structures are unable to significantly alter the flow pattern of these streams during peak flows. Thus, the delineated wetlands are natural wetlands that

are hydrologically connected to Pit River and/or Ash Creek. Irrigation practices, including operation of the Gerig Dam were not responsible for creation of the delineated wetlands. The delineated wetlands would be sustained by natural flows from Pit River and Ash Creek.

Conclusions

31. The following conclusions were drawn:

    a. The Akers property has 2,889 acres of natural wetlands (located as shown in Figure 4).

    b. These wetlands are hydrologically connected to Pit River and/or Ash Creek and are very similar to wetlands occurring in unirrigated areas.

    c. Other portions of the property are periodically inundated sufficiently by diversion of water through various channels to allow some wetland plant species to exist, but soils in these areas do not display hydric characteristics.

PART III: PREVIOUS AGRICULTURAL ACTIVITIES

Approach

32. Limited information had previously been documented about past agricultural activities on the Akers property. Such information was needed by the SPK to determine normal farming operations (if any) that had previously occurred on the property and to evaluate the wetland for agricultural production. Therefore, area residents familiar with past agricultural activities on the property were interviewed.

Methods

33. Data were obtained from discussions with several local residents and others familiar with the past agricultural activities and wildlife use of the area. A standard format (Appendix C) was established for the interviews. Several local citizens were contacted by Mr. Tom Moss (ranch foreman) and scheduled for interviews in Mr. Akers' office. During the interviews, these individuals were also asked for names of other key people to contact. Mr. John Bartell was often suggested as a key person. Mr. Bartell, who had been the foreman and later the owner of the property (1942-1973), and his son were interviewed at Mr. Bartell's home in Sprague River, Oreg. Mr. John Weldon was also interviewed at his home near Adin, Calif. Mr. Weldon was familiar with past agricultural activities on the property, as well as its past use by wildlife. The aforementioned interviews (a total of seven) were taped on microcassettes and subsequently transcribed. The original copy of each tape was provided to SPK, and a copy of each was provided to Mr. David Williams, Lockheed Corp., who was conducting a historical land use study for SPK, based on aerial photography.

Results

34. A list of individuals interviewed and the transcribed interviews are provided in Appendix C. Major emphasis was placed on the interview with Mr. Bartell and his son because most other interviewees stated that the

Bartells would be most knowledgeable about past agricultural activities. Key findings of the interviews are presented below:

a. The tule marsh was hayed and used for grazing prior to 1942.

b. From 1942-1973, the tule marsh was not hayed but was used for grazing.

c. The sedge-rush marsh was hayed and grazed prior to 1973.*

d. One attempt to cultivate oats and alfalfa in a portion of the sedge-rush marsh prior to 1942 (the year could not be determined) was unsuccessful, presumably because the area was too wet.

e. Tillage associated with cultivation of crops (e.g. barley and oats) generally has been confined to elevations occurring above the wetland boundary depicted in Figure 4.

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* This area was not tilled, and the hay consisted primarily of native vegetation. This was also confirmed by a 1931 land use map describing this area as meadow pasture (California Division of Water Resources 1931).

PART IV: WETLANDS EVALUATION

Approach

35. The public interest review process for evaluation of wetland areas requires assessment of many wetland functions (Section 404(b)(1) of the CWA of 1977). A wetland evaluation procedure that considers most known wetland functions has been developed for the US Federal Highway Administration (FHWA) (Adamus 1983). The FHWA technique (hereafter referred to as the Technique) utilizes office data, field data, and quantitative data to indicate a high, moderate, or low probability that the wetland under review can provide a particular function. The Technique, which evaluates 11 potential wetland functions, was utilized to assess the wetlands in the project area.

36. The Technique does not routinely assess the importance of a wetland for production of agricultural crops. However, agricultural production may be particularly relevant in the project area; thus, it was important to include the significance of the wetland area to perform this function (see Part III).

37. Evaluation of wetlands on the property was, of necessity, based on presently available information and field observations made at a single point in time. Although the evaluation resulted in the most definitive possible assessment with the available data, other information and additional field observations could lead to changes in some functional significance ratings. Thus, the following assessment should be considered as preliminary.

Methods

Office data

38. Much information needed to implement the Technique was derived from existing aerial photos, USGS quadrangle maps, and other similar sources. Such information can be used to define wetland configuration, drainage patterns, distribution of general vegetation types, and other factors that reflect the potential capability of a wetland to perform certain functions.

Field data

39. Some required information for implementation of the Technique was available only by direct field observation. Plant growth habits and species diversity, wildlife utilization, and water depth are examples of wetland

characteristics determined during a site visit conducted 11-19 June 1984. Site characteristics were determined from observations made along transects of the wetland area (see Part II). Observations were also made during a helicopter flight on 12 June 1984. Ground reconnaissance of other areas of the wetland watershed was performed on 14-17 June 1984.

Quantitative data

40. Quantitative data (e.g. specific water quality parameters, stream velocities, and benthic invertebrate density) can be incorporated into the Technique when available. Such data are not required to evaluate the wetland, but can be used to strengthen conclusions. Due to time constraints and substantial temporal variability of many factors included in the quantitative data portion of the Technique, few data were collected. Instead, published and unpublished information on water quality and other factors, as well as a detailed hydrologic assessment (Part II), were utilized.

Interviews

41. The Technique also utilizes input that reflects priorities of local residents. Several individuals with knowledge of past agricultural activities and wildlife use of the property were interviewed (Part III), and appropriate information was incorporated into the assessment.

Definitions

42. To interpret results of the assessment, several basic terms must be defined (Adamus 1983):

a. Opportunity - the chance for a wetland to fulfill a particular function.

b. Effectiveness - the probability of a wetland being productive in maximizing the opportunity given it to fulfill a particular function.

c. Significance - the degree to which the performed function is valued by society, as partly reflected by its scarcity.

d. Functional rating - the interaction of assigned opportunity and effectiveness probabilities.

e. Functional significance - the interaction of assigned functional rating and significance probabilities.

Results

43. The Technique requires the evaluator to answer specific questions about the physical, chemical, and biological characteristics of the wetland.

Answers to questions found in the Technique (Adamus 1983) are presented in Appendix D. Sources of information used to answer each question are presented in Table 4. Results are summarized in Table 5. Figure 6 illustrates the wetland impact area,* basin, subwatershed, and functional watershed. The wetland impact area and the basin were considered to be the same for this study, based on definitions (Adamus 1983) and physical characteristics of the project area. Fauna observed on the property are listed in Appendix B, Section 2.

Discussion

44. The Technique examined wetland functions and considered the opportunity and effectiveness of the wetland to perform most functions. These characteristics were collectively considered as the functional rating (Table 5). The significance of each function to human benefit was also considered and was combined with the functional rating to determine the wetland's functional significance. The Technique does not provide a mechanism whereby rankings of each function are combined to provide a single indicator of wetland importance, because human priorities differ among functions.

45. Two functions that appeared to be of major significance to local residents were agricultural production and wildlife habitat. The former was discussed in Part III. The latter is discussed below in greater detail than for other functions. The detail with which habitat value is discussed parallels public concern and available data.

Wildlife habitat

46. The Technique assesses the value of the wetland for wildlife habitat from several aspects: general wildlife diversity, harvested waterfowl, and wetland-dependent birds (excluding waterfowl). An evaluation was conducted for each category.

47. General wildlife diversity. Assessment of general wildlife diversity provides a measure of whether the annual total of wetland-dependent species recorded in the area is likely to be great (Adamus 1983). It implies that the wetland must support a diversity of species in winter as well as summer. The evaluation indicated a high probability that the area supports a greater total annual diversity of wildlife species than might be supported by

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* See Adamus (1983) for definitions of terms.

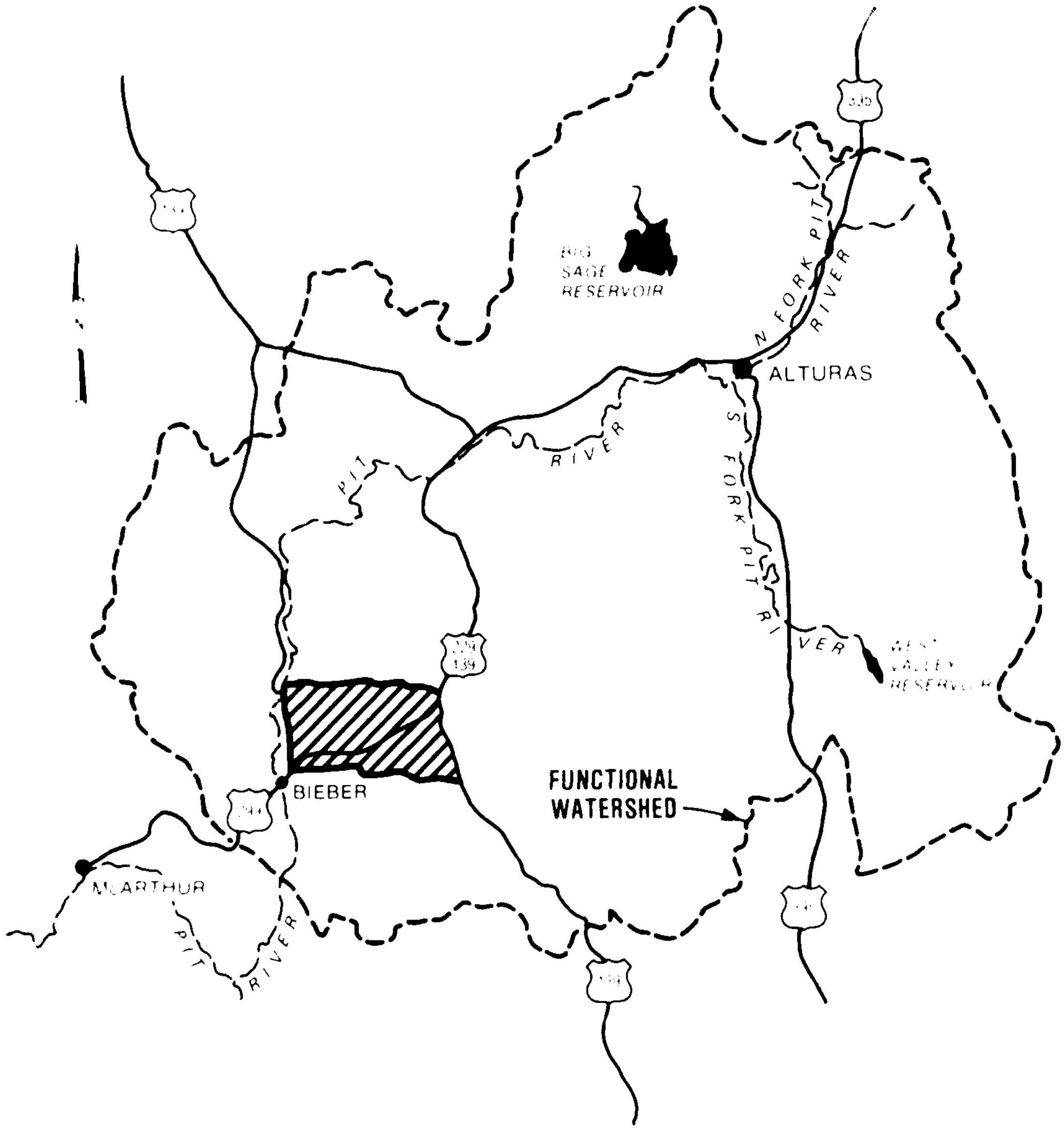

Figure 6. Map showing functional watershed and wetland impact area. The wetland impact area is shown by the diagonal lines

other wetlands of the same type in its ecoregion during periods when the marshes are not frozen over. When the marsh freezes over, birds must utilize nearby farmlands for food (US Fish and Wildlife Service 1981). Thus, the Technique indicated a moderate functional rating on an annual basis.

48. The high potential for substantial general wildlife diversity throughout most of the year is supported by the wetland physical characteristics, field observations made from 11-19 June 1984, personal interviews, and

information obtained from Federal and State resource agencies.

49. The wetland lies within a major flight lane of the Pacific Flyway and represents a major nesting area for many waterfowl species. Aerial waterfowl breeding surveys conducted by the California Fish and Game Department during 1980-1983 indicated considerable nesting by mallards, pintails, gadwalls, cinnamon teal, and Canada geese. During ground reconnaissance, numerous waterfowl were observed in all nesting stages from egg laying (Photo 19) to immature development (Photo 20). The greater sandhill crane, currently listed as rare on California's List of Endangered and Rare Fish and Wildlife (California Department of Fish and Game 1980), has been reported to nest in the area by Littlefield (1982); Naylor, Miller, and Foster (1954); and local residents.* These birds were also observed in the wetland area on every day of the site visit (Photo 21), although no confirmed nests were located.

50. During field observations, a wide variety (Appendix B, Section 2) of wildlife species were observed in addition to those discussed above. Observations within the wetland and in the immediate vicinity (1 mile) of the wetland revealed nests of several raptors, numerous passerines, and shorebirds (Photo 22). Many species were also observed resting in the area (Photo 23). Pronghorn antelope (Photo 24) and mule deer (Photo 25) were observed grazing in the wetland and surrounding areas.** Jackrabbits, sage grouse, and badgers were observed within the property boundary, but outside the wetland area. The area near Pilot Butte on the north side of the property has been identified by Bureau of Land Management (BLM) biologists as important antelope kidding grounds and sage grouse strutting grounds. According to a report that examined environmental conditions in Big Valley for the proposed Allen Camp Project (US Fish and Wildlife Service 1981), the Big Valley area is one of the most important areas for antelope in California. The study also found that Big Valley is one of the few areas in California that contains huntable populations of sage grouse.

51. Muskrat, mink, raccoon, and weasel provide an important resource for furs (US Fish and Wildlife Service 1981). Muskrats are abundant in the marsh and channels on the Akers property. Nearly 2,000 pelts are harvested

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* Personal communication, 1984, [illegible] Weldon, Adin, Calif. (see paragraph [illegible]).

** Identifications of mammal species were made using Burt and Grossenheider ([illegible]).

annually from the Big Valley region, and muskrats represent the majority (US Fish and Wildlife Service 1981).

52. Although general wildlife diversity of the wetland was considered moderate on an annual basis because the marsh freezes over in winter, the area continues to provide limited habitat at that time. Raptor surveys conducted by BLM personnel in mid-February to early March 1980-1984 indicated abundant occurrence of these birds in or near the wetland area. Observations within the wetland area have been relatively limited because access is difficult. A raptor survey conducted on 24 February 1982 revealed 48 bald eagles in the Big Valley area, many within 2 miles of the marsh. These Federally protected endangered birds likely prey upon waterfowl,* which begin utilizing the wetland during spring migration (US Fish and Wildlife Service 1981). Another endangered species, the American peregrine falcon, has also been observed in the area.**

53. The Technique indicated a high opportunity and effectiveness of the wetland to provide general wildlife diversity (exclusive of winter constraints), but the rating was moderate on an annual basis because of winter freezing conditions. The Technique also considered the social significance of the wetland, which reflects regional priorities. The social significance of the wetland was considered high because the wetland is utilized by several animals considered as rare or endangered by Federal and/or State laws. Therefore, the overall rating of the wetland for general wildlife diversity was high (Table 5).

54. Harvested waterfowl. Waterfowl habitat requirements vary substantially among species and seasons. The Technique stratifies waterfowl into nine groups, each having generally similar species requirements. The evaluator is required to select those groups most likely associated with the particular wetland being assessed. Two groups were evaluated in this study: (a) dabbling ducks that prefer grassland wetland types, and (b) inland swans and geese. Because seasonal requirements also vary considerably, seasonal characteristics were evaluated for summer/breeding habitat and wintering/migration habitat for each group.

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* Personal Communications, 1984, Jim Gordon, National Park Service, Adin, Calif., and John Weldon, op. cit.

** Personal Communication, 1984, John Weldon, op. cit.

a. <u>Dabbling ducks.</u> This broad group of ducks includes mallards, pintails, American widgeon, shoveler, gadwall, mottled duck, cinnamon teal, blue-winged teal, and green-winged teal. Most of these species were observed in the marsh during the June site visit. The evaluation indicated a high probability that the wetland is used in summer by these species. Annual aerial breeding surveys conducted by the California Fish and Game Department also indicated substantial nesting of these species. Nesting (Photo 19) and rearing of young (Photo 20) were observed during the site visit. Big Valley is one of the major waterfowl producing areas in the State of California. Modoc and Lassen Counties ranked second and third, respectively, in importance for waterfowl production (California Department of Fish and Game 1983). The functional significance, which reflects the wetland physical characteristics as breeding habitat for dabbling ducks and the social significance of the wetland, was determined to be high (Table 5). The evaluation also indicated that the wetland has high importance during spring and fall migration and during ice-free periods in winter. Waterfowl migration occurs in two peaks in Big Valley. Fall migration occurs from September to November, and spring migration occurs from February to April (US Fish and Wildlife Service 1981). During freeze-overs, waterfowl use of the marsh is limited. Waterfowl hunting in Big Valley attracts local residents, as well as hunters from other areas of the state (US Fish and Wildlife Service 1981). Many areas of Big Valley are leased for waterfowl hunting. Therefore, the functional significance of the wetland is high for wintering and migration use by waterfowl.

b. <u>Swans and geese.</u> Major taxa of concern in this group are the Canada goose and one subspecies, the cackling goose. The cackling goose nests in the Yukon-Kuskokwim Delta, Alaska, and utilizes the marsh as a winter staging area. This subspecies is discussed further in paragraph 56.

55. The US Fish and Wildlife Service (1981) considered Big Valley to be an important Canada goose nesting area. Annual aerial waterfowl breeding surveys also indicated considerable nesting. Many nesting areas were observed during the June site visit, and geese were observed in the marsh, primarily on the western side of the property near deeper water and in an area northwest of the property. The incubation period for Canada geese is usually from March through May (US Fish and Wildlife Service 1981), so the goslings were probably off the nests by the June site visit. It was reported that broods were off the nests on 21 May 1984.* Although Canada geese were not abundant in the marsh during the June site visit, nesting activity was apparent, and the

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* Personal Communication, 1984, John Hayes, California Department of Fish and Game, Sacramento, Calif.

functional significance was considered high.

56. The wetland also provides important wintering habitat for both Canada geese and cackling geese as a wintering and staging area. The population of cackling geese has declined dramatically in recent years, resulting in a cooperative study involving Federal and State natural resource agencies. The Technique indicated a high probability that the wetland is regularly used by geese during spring and fall migrations and in winter during ice-free periods. The functional significance was also considered to be high.

57. Wetland-dependent birds. The Technique provides a mechanism to assess the importance of the wetland to selected species of birds dependent upon these areas during all or part of their annual activities. Four avian species were evaluated (Table 5). The evaluation indicated a high and moderate probability (functional rating) that the wetland is used for nesting and wintering/migration by the greater sandhill crane and Wilson's phalarope, respectively. Greater sandhill cranes are officially listed as rare in California, and consequently had a very high functional significance. Wilson's phalarope winters in southern South America (Peterson 1961), but likely uses the area during migration. The wetland was also assessed to be of moderate importance on an annual basis to the long-billed marsh wren. The Technique did not provide a mechanism for evaluating nesting or wintering habitat for this species. However, numerous long-billed marsh wrens and their nests were observed in the tule marsh. Peterson (1961) indicated that this species utilizes habitats characteristic of the tule marsh. Therefore, this area is likely to be highly important for nesting of long-billed marsh wrens. The importance of the wetland to bald eagles was also assessed, but only on an annual basis. The wetland was determined to have a low probability of use (functional rating) by bald eagles. This is not surprising on an annual basis, since the wetland does not provide nesting habitat. However, numerous eagles have been observed in the vicinity of the wetland during fall migration, at which time the wetland attracts waterfowl, an important food source for the eagles. The functional significance of the wetland was considered moderate for bald eagles, since this species is officially listed as endangered by Federal and State agencies.

Fishery habitat

58. The Technique provides two approaches for assessing fishery habitat: assessment for a functional group (i.e. warmwater or coldwater fishery),

and assessment for particular species of concern. The warmwater fishery group was assessed in this study, since the US Fish and Wildlife Service (1981) indicated that fishery resources in the area consist primarily of warmwater species.

a. Functional group. The evaluation indicated a moderate probability that the area is regularly used by warmwater species. The channels, particularly in the western end of the wetland, may provide limited fishery habitat, since access to the Pit River is available during portions of the year. However, this assessment seems somewhat optimistic since the wetland contains little standing water during part of the year.

b. Species. Assessment of wetland use by particular warmwater species (e.g. channel catfish, largemouth bass, and bluegill) indicated a low probability (functional rating) that any of these species use the wetland (Table 5). Fish use is likely limited to *Gambusia* sp. and other minnow-type species. The functional significance of the wetland was also determined to be low for these species because little fishing occurs in the portion of the Pit River and its adjacent sloughs within Big Valley (US Fish and Wildlife Service 1981).

59. The Technique does not provide necessary information to assess the importance of the wetland for the Modoc sucker, a species officially classified as endangered by the State of California (California Department of Fish and Game 1980). However, this species is known to occur in Ash Creek and Willow Creek in Lassen County and several creeks in Modoc County (California Department of Fish and Game 1980).

Food chain support

60. Food chain support pertains primarily to use of nutrients by fish and aquatic invertebrates of commercial or sport value (Adamus and Stockwell 1983). Channel catfish is the principal species of commercial or sport value. No invertebrate species were identified as commercially or recreationally valuable. The Technique assesses both downstream and in-basin support, and each is discussed below.

61. Downstream transport and utilization. Interchange of nutrients and primary productivity between the wetland and Pit River downstream from the wetland are constrained by various irrigation control structures during low-flow periods. This and other factors influence downstream support for food chain values. The evaluation indicated a moderate probability (functional rating) that the basin has significantly greater and more sustained net annual primary productivity than most unmanaged terrestrial systems. The probability

is also moderate that organic matter produced by the wetland is more totally and evenly distributed among downstream animal users than for terrestrial systems. The functional significance of the wetland for downstream transport and utilization was also considered moderate.

62. <u>In-basin cycling and food chain support.</u> The probability is moderate (functional rating) that the wetland is critical to support some aquatic food chains within the wetland basin, due to: (a) the wetland having significantly higher sustained productivity than most unmanaged terrestrial or deepwater systems, (b) the basin's ability to concentrate nutrients, and/or (c) the basin's ability to flush nutrients from the wetland into deepwater areas. The functional significance was moderate.

<u>Ground-water recharge</u>

63. Ground-water recharge involves the movement of subsurface water or precipitation into the ground-water flow system (Adamus and Stockwell 1983). Movement is usually downward. This wetland function is influenced by hydroperiod, sediment type, wetland system, wetland position within the watershed, and several other factors (Adamus 1983). The wetland evaluation indicated a low probability that: (a) recharge to ground water exceeds ground-water discharge to the wetland on a net annual basis and/or (b) the rate of recharge to the ground water exceeds the rate of recharge to the ground water from nearby terrestrial environments. The wetland occurs in an area where evaporation exceeds precipitation, so the opportunity for recharge is low.

64. The social significance of the wetland for providing ground-water recharge was considered moderate, since virtually all potable water and substantial irrigation water are derived from wells. Therefore, the functional significance of the wetland for ground-water recharge was moderate.

<u>Ground-water discharge</u>

65. Ground-water discharge involves the movement of ground water into surface water (Adamus and Stockwell 1983). Movement is usually upward and is often observed as springs. Factors that influence ground-water recharge into a wetland also influence ground-water discharge from a wetland. Several of these factors are listed above.

66. Evaluation of the wetland indicated a moderate probability that ground-water discharge to the wetland exceeds recharge to the ground water on a net annual basis. The functional significance was considered moderate.

Flood storage and desynchronization

67. Flood storage is the process by which peak flows enter a wetland and are attenuated in their downslope movement (Adamus and Stockwell 1983). This process can be important in reducing downstream flooding.

68. The Technique utilizes information derived primarily from field observations to assess flood storage. Therefore, the Technique is less sensitive than if based on detailed studies. Detailed analysis of surface hydrology is provided in Part II. Results indicated a moderate probability that: (a) peak flows reaching the wetland are attenuated in their downslope journey, and (b) such attenuation, when considered along with attenuations created by wetlands and basins elsewhere in the watershed, results in desynchronization of peak flows and ultimate reduction in downstream flood stage. Although effectiveness was assessed as moderate, there is a low probability that the wetland will have an opportunity to provide this function, since peak flows entering the wetland are flashy. Much of the inundation results from overbank flooding of Pit River. The wetland is upstream from several small towns such as Bieber and Nubieber. These towns could benefit from any flood storage capacity provided by the wetland, so the functional significance of the wetland was considered moderate.

Shoreline anchoring

69. Shoreline anchoring involves the stabilization of soil in shallow water or at the water's edge by fibrous plant root systems (Adamus and Stockwell 1983). It may include long-term accretion of sediments and/or peat, along with shoreline progradation. Streambank and channel erosion were observed on the property, particularly along the eastern side (Photo 26). However, wetland vegetation appeared to provide an effective stabilizing mechanism, since most streambank erosion resulted from undercutting of the banks. Observations in the marsh during wetland delineation activities indicated the presence of a dense root mass that retards erosion. The wetland evaluation indicated a high probability that the wetland is more effective at binding soil and/or dissipating erosive forces than fastlands on either side of the wetland. There is also a high probability that the wetland is exposed to appreciable erosive forces within the channels, as indicated by interviewees (Appendix C). The functional significance of the wetland for shoreline anchoring was high.

Sediment trapping

70. Sediment trapping is the process by which inorganic particulate matter of any size is retained or deposited within a wetland or its basin (Adamus and Stockwell 1983). Wetland vegetation on the property was very dense and, therefore, potentially conducive to sediment trapping. The gradual change in wetland gradient from the upstream to downstream end of the property, particularly between Transect III and the Bieber-Lookout Road, is also beneficial to sediment trapping. These features and others considered in the evaluation resulted in a high probability that the wetland is effective in trapping and retaining appreciable amounts of inorganic sediments. The evaluation also indicated a moderate probability that appreciable amounts of inorganic sediments are carried into the wetland via runoff or surface flow. This assessment was constrained by lack of inflow and outflow measurements of suspended solids. The functional significance of the wetland was considered high for sediment trapping, since potential increases in suspended solids from the wetland could negatively influence fishery resources in the Pit River downstream from Big Valley.

Nutrient retention

71. Nutrient retention is the storing of nutrients (primary nitrogen and phosphorus) within the wetland substrate or vegetation (Adamus and Stockwell 1983). Several factors (e.g. hydroperiod, vegetation type, and current velocity) influence effectiveness of the wetland to perform this function. Assessment of nutrient retention was accomplished by considering both long-term and seasonal retention. Each is discussed below.

72. Long-term retention. Assessment of the potential effectiveness of the wetland to provide long-term retention of nutrients indicated a high probability that the wetland is more effective than most nonwetland environments for removing or retaining nutrients for long periods. However, limited water quality information was available to assess concentrations entering or leaving the wetland. There is a moderate probability that appreciable amounts (especially amounts of sufficient magnitude to cause downcurrent algal blooms) of nutrients are carried into the wetland. The functional significance of the wetland for long-term nutrient retention was high.

73. Seasonal retention. Evaluation indicated a moderate probability that the wetland is more efficient than most nonwetlands for temporarily retaining nutrients during the season in which nuisance algal blooms are most

likely to occur, both downcurrent and in the wetland. The probability is also moderate that appreciable amounts of nutrients are likely to enter the wetland from channel or surface runoff. The functional significance of the wetland for seasonal retention of nutrients was moderate.

Active recreation

74. Active recreation, as used in the context of this evaluation, refers to recreational activities that are water dependent and can occur either in an incidental or obligatory manner in wetlands (Adamus and Stockwell 1983). Activities assessed in this evaluation include swimming, boat launching, power boating, canoeing and kayaking, and sailing. The shallow character of the wetland, density of emergent vegetation, and limited access influence the recreational character of the wetland. The evaluation revealed a low probability that the wetland will be useful for the assessed recreational activities. The functional significance of the wetland was considered low.

Passive recreation and heritage

75. Passive recreation and heritage encompasses a wide variety of wetland uses including aesthetic enjoyment, nature study, open space, education, scientific study, preservation of rare or endemic species, maintenance of the gene pool, protection of archaeological or geologically unique features, and other uses (Adamus and Stockwell 1983). The evaluation procedure does not provide a mechanism for assessing physical attributes to determine the opportunity or effectiveness of the wetland to provide these uses. These functions primarily reflect local concerns and priorities (social significance) that are considered in the Technique. Wetland significance for passive recreation and heritage was high, primarily because the wetland provides important habitat for a variety of rare or endangered wildlife species (e.g. greater sandhill cranes and bald eagles). Based on interviews with local residents and personnel from State resource agencies, the cackling goose also utilizes the wetland as a winter staging area. The declining population of this species imparts an additional importance to the wetland.

Conclusions

76. Wetlands on the property are highly valuable for several wildlife, hydrologic, and water quality functions. The wetland provides important habitat for several officially recognized rare or endangered wildlife species,

most notably the greater sandhill crane. It is also an important breeding and/or wintering habitat for ducks and geese. The wetland provides valuable shoreline anchoring and sediment trapping functions, both of which result in reduced discharge of suspended solids that may damage the downstream fishery. The wetland was assessed to be very effective in removing nutrients (primarily nitrogen and phosphorus), particularly over the long term.

PART V: PROJECT IMPACTS

77. Assessment of environmental impacts of the proposed project was based on the project description contained in the administrative file provided by SPK. Of special significance was the letter dated 27 April 1984 from Mr. Lanny Winberry, Mr. Akers' attorney, to Mr. Robert Junell, SPK, explaining how the project would function. Additional information used in assessing project impacts was gained from onsite inspection, interviews with local residents, and various reports and scientific studies. The assessment was of necessity largely qualitative, due to the unavailability of sufficient data for a quantitative assessment. The assessment considered potential impacts on the wetlands, nonwetlands, and surrounding areas. Impact assessment included both project benefits and detriments.

78. Assumptions followed during the assessment were that:

a. The proposed project would function as described in the above-referenced letter.

b. Without the project, agricultural activities (i.e. pasturing and harvesting of marsh hay) in the wetlands would remain essentially unchanged.

Hydrologic Impacts

General impacts

79. Although the proposed project is considered by the landowner to be an irrigation project, it could also serve to drain the wetlands. The proposed system will provide water control that will enable production of dryland crops. To accomplish this goal, the project is designed to enable the removal or addition of water in a manner that does not now occur. The project could serve to exclude water from the farm fields. This could be accomplished by: (a) diverting a portion of Ash Creek flow through Big Valley Canal, (b) excluding Pit River water by a levee on the west side of the property (except in a 100-year flood event), and/or (c) pumping water into the proposed reservoir. These features would result in much less water entering the property. The project also has features that could serve to remove excess water from the fields. The large lateral canals will accelerate drainage from the east side of the property to the west side. This could result in ponding of water on the west side of the property. Since the ponded water would limit

agricultural activities in this area, removal of the ponded water would be necessary. The water could be released as overland flow through the proposed gate when the water level on the east side of the levee is higher than the water level on the west side of the levee. In the reverse situation, water could be pumped over the levee. Controlling the water level as stated above would enable the landowner to place maximum acreage into dryland agricultural production. The proposed water management practice would ultimately eliminate most wetland plant communities found on the property. This would be a major detriment of the project.

Flood storage

80. Since the proposed project includes a canal to intercept or divert all Ash Creek flow on the east side of the property and a levee to exclude Pit River water on the west side of the property, there would be a significant loss of opportunity for flood storage in the wetlands. Flood storage capacity would be limited to water that could be stored in the irrigation canals and in the proposed reservoir.

Ground-water recharge

81. The opportunity and effectiveness of this function are low at present, but could slightly increase with the project due to tillage, especially in areas where a hardpan currently exists. However, even with the project, ground-water recharge would not be a major function because increased percolation rates would be partially offset by increased evapotranspiration rates.

Ground-water discharge

82. This function is currently not significant. With the project, ground-water discharge would be expected to increase due to pumping activities. In addition, confinement of water to channels could reduce the water table during periods when the water level in the channels is below the ground surface. This could be considered as a project detriment, due to potential reduction of the water table of the area.

Floodwater desynchronization

83. Although this function would be essentially lost, it is not currently a significant wetland function. Only a relatively small percentage of the total Pit River flow enters the property at present. There would be reduced potential for desynchronizing floodwaters from Ash Creek. Significant diversion of Ash Creek waters through Big Valley Canal could increase flooding potential in this part of Big Valley.

Erosion abatement and shoreline stabilization

84. Erosion potential in the project area would be expected to increase, especially in channels. Tilled portions of the area would be subjected to increased erosion (by both wind and water) during portions of the year. Since flow rates in Big Valley Canal could be increased as water is diverted from the property, erosion potential in this waterway would increase. This could be a major project detriment.

Evapotranspiration

85. Evaporation rates would be expected to increase, perhaps significantly, due to decreased vegetative cover and increased open-water surface area. Transpiration rates would not likely change. This is not considered to be a major impact.

Water Quality Impacts

Sediment retention

86. The wetlands currently provide a significant sediment retention function for both Pit River and Ash Creek waters. Onsite inspection revealed that sediment loads on Ash Creek are high at times, and large quantities of sediments are deposited in the wetlands as flows are dispersed in the wetland basin. Thus, the wetlands act as a sediment filter. Increased diversion of Ash Creek water through the Big Valley Canal could likely increase the quantity of sediments entering the Pit River. This could significantly impact downstream water quality and fisheries. Confinement of Ash Creek waters to the proposed irrigation system could lead to sufficient sedimentation within the canals such that maintenance dredging would be required periodically.

Nutrient retention

87. The same project impacts as described for sediment retention (paragraph 86) apply to nutrient retention. Due to farming activities in the Ash Creek area, loss of the nutrient retention function of the wetlands could be a significant project detriment.

Heavy metal immobilization

88. There are no projected impacts of the project on heavy metal immobilization. Although not assessed in Part IV, it is thought that the

opportunity for the wetlands to perform this function is low at present and would remain low with the project.

Pesticide loading

89. The role of the wetlands in reducing pesticide loading in the Pit River is unknown. However, pesticide concentrations in water and soils of the property would likely increase with the project. This could impact populations of certain avian species (particularly raptors).

Fish and Wildlife Habitat Impacts

Loss of habitat

90. With the project, 2,889 acres of valuable wildlife habitat would be significantly degraded. This negative impact is accentuated by the fact that the existing habitat constitutes a major portion of the available wetlands in Big Valley. Most other portions of the Ash Creek and Pit River floodplains have already been developed, and no comparable wetland acreage exists elsewhere in the area. The diversity of habitat (including wetlands) currently present on the property supports a wide variety of wildlife (see Appendix B, Section 2). Loss of the wetlands would affect not only those species directly dependent on the wetlands as a food source and as breeding habitat, but also other species (e.g. mule deer and antelope) that incidentally utilize the area. It is unclear whether the proposed plan includes an area of wetlands to be left intact. However, the integrity of any remaining wetlands would be affected significantly by changes in hydrology. To successfully implement the project and achieve its intended use, it would be imperative that standing water be kept off the area as much as possible (except during periods when irrigation practices are carried out). Thus, less water would be available to any remaining wetlands due to:

a. Confining water to irrigation channels.

b. Lowering the water table by pumping of ground water.

c. Increasing percolation rates by breaking the hardpan and soil tillage.

Due to these factors, any remaining natural wetlands would eventually be replaced by upland plant communities.

Fish

91. Wetlands of the project area are currently relatively unimportant

for fisheries production. A fishery could be created in the proposed reservoir. Downstream fisheries in the Pit River could be significantly impacted due to effects of increased sediment, nutrient, and pesticide loading on fish spawning and phytoplankton production.

Waterfowl

92. Although the project may actually increase availability of food for wintering geese, overall impacts of the project on waterfowl would be highly detrimental. This is probably the greatest single project detriment. The wetlands currently provide significant habitat for large numbers of waterfowl. Nesting habitat would be virtually eliminated. Significant numbers of ducks and some geese currently nest in the area. The increased food supply for wintering geese that would be provided by the proposed project is not significant because there is already an abundant food supply in the area. However, lounging (resting) areas for both ducks and geese would be significantly reduced. This could significantly affect use of the site as a staging area for geese, especially cackling geese. Use of the area by diving ducks would probably increase to some degree by construction of the reservoir.

Rare and endangered species

93. Several species that appear on either the State or Federal list of rare and endangered species currently utilize the area.

a. Greater sandhill crane. This species would be negatively impacted to the greatest degree through elimination of breeding habitat, feeding habitat, and increased disturbance. Big Valley is one of two major nesting areas for this species in California; thus, the area could be considered as critical habitat. Numerous individuals were observed feeding and lounging in the wetlands of the property. Proposed agricultural activities would result in increased disturbance during the breeding period, which could significantly impact nesting success.

b. Bald eagle. The project would impact the available food supply (primarily ducks) for bald eagles and could also result in increased disturbance of this species as agricultural activities are increased. This could be a significant detriment of the project. The project area is not utilized as a nesting site.

c. Peregrine falcon. Since this species utilizes ducks (especially young ducks) as a principal food source, the loss of nesting habitat for ducks due to the project could significantly affect potential use of the area by peregrine falcons. At present, peregrine falcons are seldom seen in the area. However, as the population continues to redevelop, this could become an important area for the peregrine falcon.

Shorebirds

94. The area is currently heavily utilized by a great diversity of shorebirds (e.g. willets, plovers, sandpipers, and stilts). Due to the expected confinement of water to channels and the reservoir with the project, these species would be affected through reduced food supply and nesting habitat. Some habitat would remain along irrigation canals and around the reservoir margin. Other nonresident water-dependent birds (e.g. pelicans) that utilize the area as a stopover site for lounging and feeding would also be adversely affected.

Raptors

95. Several raptors (e.g. marsh hawks, buteo hawks, golden eagles, bald eagles, and owls) currently utilize the area. Of these, the marsh hawk would be affected to the greatest degree by the project. It utilizes the area for both feeding and nesting, and the project would greatly impact both activities through habitat elimination. The other species would be less affected, although conversion of wetlands to farmland would decrease the diversity of prey species available for hawks and owls.

Other birds

96. Numerous other bird species (e.g. long-billed marsh wren, red-wing blackbird, and yellow-headed blackbird) utilize the wetland area as feeding and nesting habitat. These species would utilize the area to only a small degree with the project, except for possible use of areas where wild rice would be grown.

Food chain production

97. Food chain production would greatly decrease in the present wetland area. Conversion to agricultural crops would greatly decrease species diversity and would significantly alter energy available to all trophic levels.

Upland species

98. Principal upland species affected by the project include sage grouse, antelope, and mule deer. Sage grouse use the area where the reservoir is to be constructed as a breeding and nesting area. Large numbers of sage grouse were observed in this area. The same area is used by antelope as kidding grounds. Both antelope and mule deer were observed resting, lounging, and feeding in the wetlands. The project would not significantly decrease, and may increase, use of the area by both mule deer and antelope for feeding,

but the degree of lounging and resting would be decreased due to reduced cover and increased disturbance from agricultural activities.

Socioeconomic Impacts

Agriculture

99. Assuming that the project design would enable use of the entire area for alfalfa and small grain production, agricultural output would be expected to increase approximately 10-fold. For example, if 7,000 acres were to be used for alfalfa production and the annual yield is assumed to be 3 tons/acre, baling the alfalfa in 80-lb bales would result in more than 500,000 bales of hay. An estimated 55,000 bales of marsh hay have been harvested in the past (based on information provided in a letter dated 6 April 1984 from Mr. Winberry (see paragraph 77) to Mr. Gibson of SPK). Not only would total production increase, but the quality of the hay would also increase (alfalfa hay versus marsh hay). Associated with the intensified agricultural activities would be some increase in employment opportunity for area residents.

Real estate values

100. There would obviously be a significant increase in the real estate value of the property with the irrigation project installed. The land, which was purchased at $416/acre in January 1984, would increase in value to an estimated $1,200/acre (based on average value of agricultural land in the Big Valley).

Recreation

101. The project would probably slightly increase recreational benefits through creation of a potential reservoir fishery. Hunting opportunities would probably be adversely impacted, since waterfowl abundance would decrease. Because species diversity would be greatly decreased, activities such as bird watching would be reduced.

Aesthetics

102. The aesthetic quality of an area is difficult to assess, because the beauty of a landscape is perceived differently by different individuals. However, natural landscapes are often considered more aesthetically pleasing than altered areas. To those who prefer natural landscapes, the project would be a detriment. The Big Valley marsh is located in a prominent position in

the area, and the natural landscape and the present diversity of wildlife are viewed by considerable numbers of tourists.

Archaeological

103. Two tribes of Indians formerly used the area, and archaeological sites (e.g. Indian cemeteries) are present in the general area, but apparently not on the property. Pilot Butte is known to contain Indian artifacts.* Otherwise, little is known about possible archaeological sites on the property.

Summary

104. The proposed project would afford potential benefits to the owner through increased agricultural production and increased real estate values. Major potential detriments include loss of habitat for waterfowl nesting and staging areas for geese, increased erosion potential, decreased flood storage capacity, downstream effects of higher sediment and nutrient loading on fisheries production in the Pit River, and impacts on the greater sandhill crane population.

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* Personal Communication, 1984, John Weldon, op. cit. (p 31).

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Table 1

Indicator Categories* Developed by the USFWS-National Wetlands Inventory**

Category	Description†	Frequency of Wetland Occurrence, percent
OBL	Obligate hydrophytes are found almost exclusively in wetlands.	>99
FACW	Facultative wetland plant species are usually found in wetlands.	>66-99
FAC	Facultative plant species occur commonly in both wetlands and nonwetlands.	>33-66
FACU	Facultative upland plant species usually occur in uplands, but sometimes occur in wetlands.	1-33
UPL	Upland plant species do not occur in wetlands.	0

* An expression of the frequency of occurrence of a species in wetlands versus nonwetlands across the range of the species.

** Address: 217 Dade Bldg., 9620 Executive Center Drive, St. Petersburg, FL 33702.

† Definitions refer to species occurrence under natural conditions.

Table 2

Average Length of Time Various Elevations on Akers Property Are Exceeded by Surface Water During the Growing Season

Length of Time Elevation is Exceeded* percent	Elevation (feet, msl) of Transects			
	I	II	III	IV
5	4,130.3	4,131.7	4,135.0	4,139.9
25	4,129.7	4,131.2	4,133.8	4,139.5
75	4,129.3	4,131.0	4,132.7	4,139.1
90	4,129.2	4,130.9	4,132.5	4,139.0

* Including adjustment for soil saturation based on 125-day average growing season.

Table 3

Effects of Irrigation Practices on Akers Property

		Transect Number							
	Irrigation	I	II	I & II	III		IV		Total
Percent*	Condition**	Elevation†	Elevation	Area††	Elevation	Area	Elevation	Area	Area
5	With	4,130.3	4,131.7	1,771	4,135.4	1,645	4,140.0	313	3,729
	Without	4,130.3	4,131.7	1,771	4,135.0	878	4,139.9	292	2,941
	Difference	0.0	0.0	0	0.4	767	0.1	21	788
25	With	4,129.7	4,131.2	1,196	4,135.0	878	4,139.7	252	2,326
	Without	4,129.7	4,131.2	1,196	4,133.8	0	4,139.5	0	1,196
	Difference	0.0	0.0	0	1.2	878	0.2	252	1,130
75	With	4,129.3	4,131.0	756	4,134.8	439	4,139.4	157	1,352
	Without	4,129.3	4,131.0	756	4,132.7	0	4,139.1	0	756
	Difference	0.0	0.0	0	2.1	439	0.3	157	596
90	With	4,129.2	4,130.9	571	4,134.8	439	4,139.3	40	1,050
	Without	4,129.2	4,130.9	571	4,132.5	0	4,139.0	0	571
	Difference	0.0	0.0	0	2.3	439	0.3	40	479

* Percent of growing season during which elevation or area is inundated or saturated.

** Irrigation condition is for all channels having flow diverted to overland, or valley, flow. The "without" condition is what would occur naturally.

† Elevation, in feet, mean sea level.

†† Area, in acres, inundated or saturated.

Table 4

Information Sources for Assessment of Wetland Predictors*

Question	Predictor	Information Source*
Office type data		
1	Contiguity	AP, QS, FR
2	Constriction of basin or wetland impact area	AP, QS, FR
3	Shape of the basin	AP, QS, FR
4	Fetch and exposure	AP, QS, FR
5	Basin surface area	AP, QS, WD
6	Wetland surface area	WD
7	Basin area/watershed area ratio	HS, QS
8	Basin area/subwatershed ratio	HS, QS
9	Location in watershed	HS, QS
10	Stream order	NA
11	Gradient of subwatershed	HS, QS
12	Gradient of tributaries	HS, QS
13	Gradient of basin	NA
14	Perched condition	QS
15	Land cover of the subwatershed	QS, FR, PI
16	Land cover trends	PI
17	Soils of the subwatershed	PI
18	Lithologic diversity	B98
19	Delta environment	QS, HS, FR, AP
20	Evaporation balance	Mayes and George 1981
21	Wetland system	FR
Field data		
22	Vegetation form	FR
23	Substrate type	FR, WD
24	Salinity and conductivity	C75, C59
25	pH	C75, C59, PI
26	Hydroperiod	HS, FR, Table 1-Adamus (1983)
27	Flooding duration and extent	HS
28	Artificial water level fluctuations	HS, FR
29	Natural water level fluctuations	HS, FR
30	Tidal range	NA
31	Scouring	FR
32	Flow velocity	HS
33	Water depth (maximum)	HS, FR

(Continued)

* Abbreviations are as follows:

AP = aerial photos
QS = USGS quadrangle sheets
FR = field reconnaissance
WD = wetland determination - Part II
HS = hydrology study - Part II
NA = not applicable
PI = personal interviews
B98 = California Department of Water Resources (1963)
C75 = US Geological Survey (1975)
C59 = California Department of Water Resources (1959)
UN = unknown

Table 4 (Concluded)

Question	Predictor	Information Source*
Field data (Continued)		
34	Water depth (mean)	HS, FR
35	Width	FR
36	Oxygenation of sediment surface	WD
37	Morphology of the wetland, relative to the basin	QS, AP, FR
38	Flow blockage	NA
39	Basin alterations	FR, QS, AF, PI
40	Pool-riffle ratio	NA
41	Basin's vegetation density	FR, WD
42	Wetlands open water	FR, HS, QS, AF
Office type data		
43	Sheet versus channel flow	HS, FR
44	Wetland-water edge	QS, FR, AF
45	Gradient of edge	HS, QS, FR
46	Shoreline vegetation	WD, FR
47	Shoreline soils	WD, PI
48	Disturbance	PI, FR
49	Plants: form richness	WD, AF, FR
50	Plants: waterfowl value	WD, FR, Table 2-Adamus (1983)
51	Plants: anchoring value	FR, WD, Table 3-Adamus (1983)
Detailed data		
52	Plants: productivity	Table 4-Adamus (1983)
53	Freshwater invertebrate density	UN
54	Tidal flat invertebrate density	NA
55	Shoreline erosion measurements	UN
56	Ground-water measurements	UN
57	Suspended solids	UN
58	Dissolved solids	C59
59	Eutrophic conditions	UN
60	Water quality correlates	PI
61	Water quality anomalies	UN
62	Water temperature anomalies	UN
63	Bottom water temperature	UN
64	Dissolved oxygen	UN
65	Underlying strata	UN
66	Discharge differential	UN
67	Suspended solids (SS) differential	UN
68	Nutrient differential	UN

Table 5

Rating Summary for Wetland Functions

Function	Effectiveness	Opportunity	Functional Rating	Significance	Functional Significance
Wildlife habitat					
General diversity	Moderate		Moderate	High	High
Waterfowl					
Nesting - dabbling ducks	High		High	High	High
- geese	Moderate		Moderate	High	High
Wintering/migration - dabbling ducks	High*		High*	High	High
- geese	High*		High*	High	High
Wetland-dependent birds					
Sandhill crane - nesting	High		High	High	High
- wintering/migration	High		High	High	High
Bald eagle - all year**	Low		Low	High	Moderate
Wilson's phalarope - nesting	Moderate		Moderate	Moderate	Moderate
- migration	Moderate		Moderate	Moderate	Moderate
Long-billed marsh wren - all year	Moderate		Moderate	Moderate	Moderate
Fishery habitat - warmwater	Moderate		Moderate	Low	Moderate
Bluegill	Low		Low	Low	Low
Largemouth bass	Low		Low	Low	Low
Channel catfish	Low		Low	Low	Low
Food chain support					
Downstream	Moderate		Moderate	Moderate	Moderate
In-basin	Moderate		Moderate	Moderate	Moderate
Ground-water recharge	Low	Low	Low	Moderate	Moderate
Ground-water discharge	Moderate		Moderate	Moderate	Moderate
Flood storage and desynchronization	Moderate	Low	Moderate	Moderate	Moderate
Shoreline anchoring	High	High	High	High	High
Sediment trapping	High	Moderate	High	High	High
Nutrient retention					
Long-term	High	Moderate	High	Moderate	High
Seasonal	Moderate	Moderate	Moderate	Moderate	Moderate
Active recreation					
Swimming	Low		Low	Low	Low
Boat launching	Low		Low	Low	Low
Power boating	Low		Low	Low	Low
Canoeing	Low		Low	Low	Low
Sailing	Low		Low	Low	Low
Passive recreation and heritage				High	High

* Except during periods of marsh freeze-over.

** Use predominantly during migration; the Technique does not permit seasonal assessment of bald eagle.

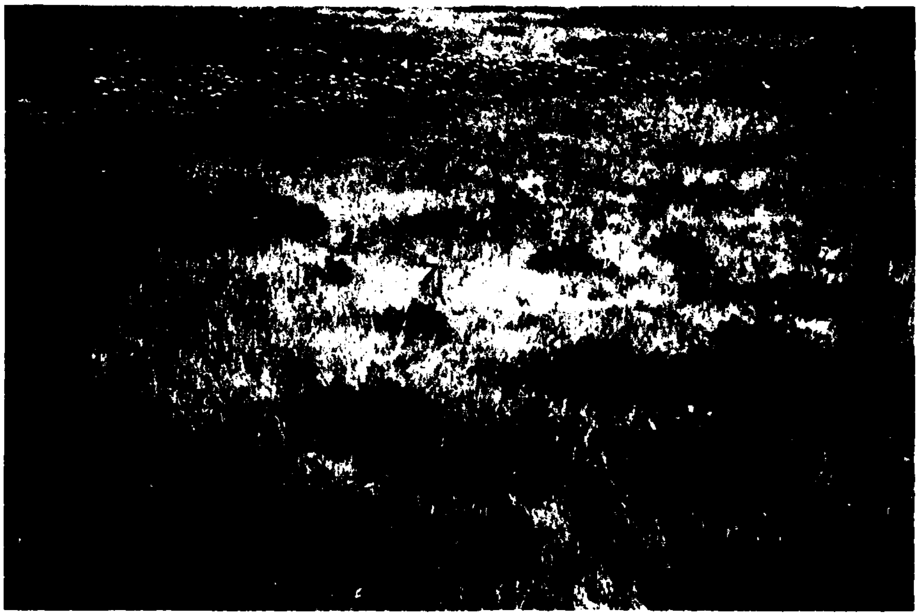

Photo 1. Starting point of transect in upland. Note wooden stake with red flagging and an orange surveyor's flag

Photo 2. Orange flag placed at 1,000-ft intervals along transects. These flags served as focal points for vegetation, soil, and hydrologic characterizations along transects

Photo 3. Typical vegetation in upland areas where transects were initiated. *Bromus mollis*, *Hordeum stebbensii*, and other upland grasses dominated this site

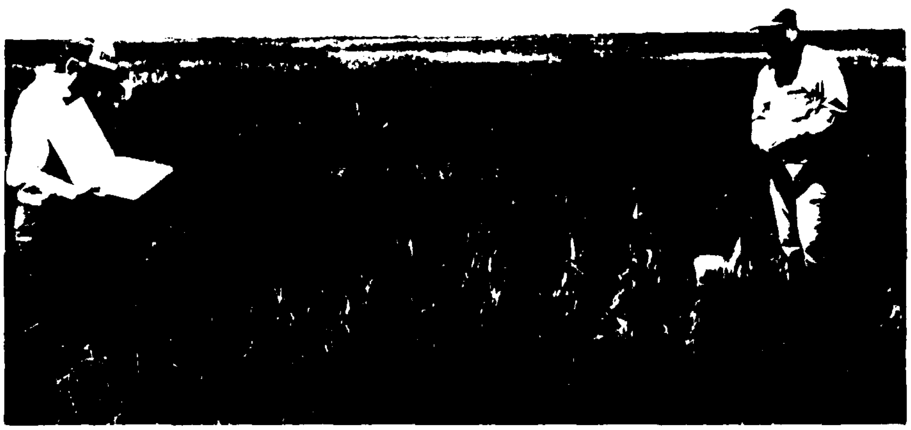

Photo 4. Vegetation characterization in plot along transect

Photo 5. Use of soil auger for obtaining soil sample. Soils were sampled at each observation point

Photo 6. Characterization of soil at observation point. Note the dark color and well-defined structure in the portion on the right side of the sample

Photo 7. Inundated area in the central portion of the property. Water depth at this location was 12 in.

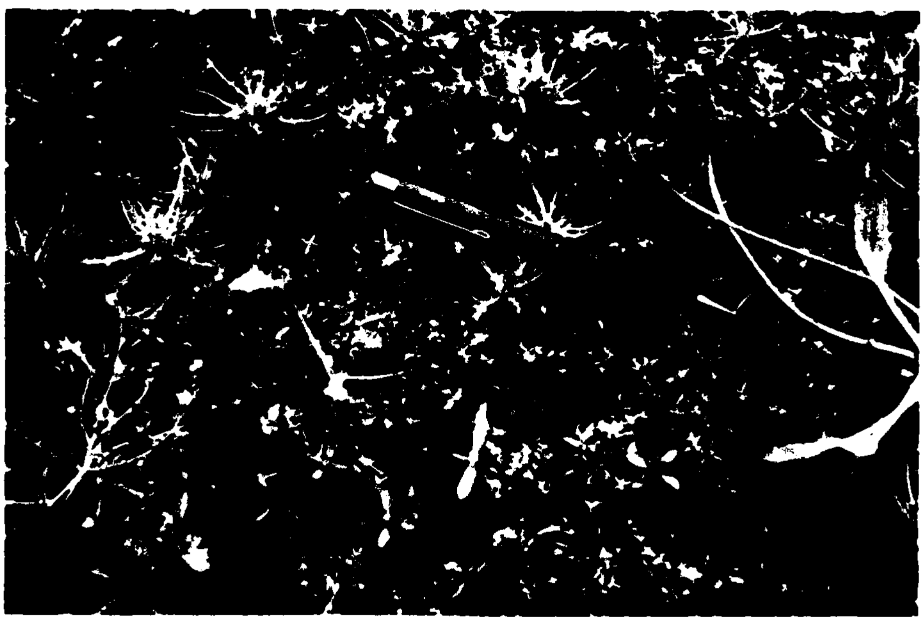

Photo 8. Encrusted detritus on soil surface. This indicates recent inundation

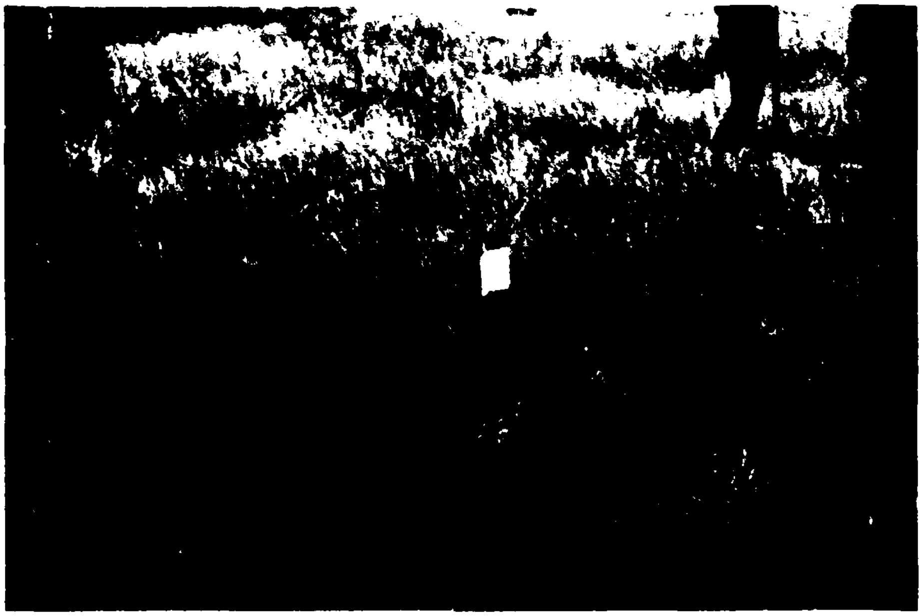

Photo 9. Yellow surveyor's flag used to mark the wetland-nonwetland boundary along transects. The area below the flag is wetlands, while the area above the flag is nonwetlands

Photo 10. Typical *Artemisia*-dominated hills and ridges

Photo 11. Typical vegetation of farm fields. *Bromus mollis* and *Poa pratensis* were usually dominant

Photo 12. Area recently inundated, probably by water diversion. Note the cracks in the soil

Photo 13. Typical vegetation in the tule marsh. The tules were 8-10 ft in height

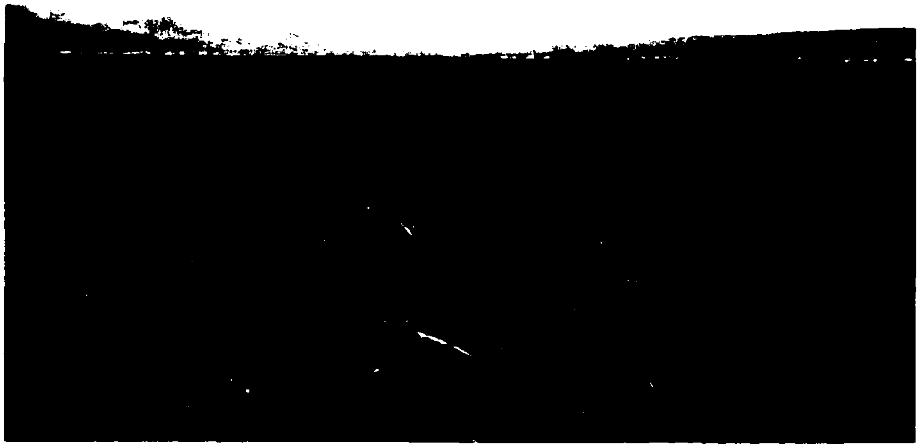

Photo 14. Typical vegetation found in the sedge-rush marsh. Dominant species were *Juncus effusus*, *Carex nebrascensis*, *Carex praegracilis*, and *Eleocharis palustris*

Photo 15. Typical vegetation found in seasonal wetlands. Dominants included *Plagiobothrys stipitatus*, *Psilocarphus brevissimus*, *Navarettia leucocephala*, and *Orthocarpus campestris*

Photo 16. Typical wet channel found in eastern portion of the property. Many were unvegetated, while others contained submersed aquatic plants

Photo 17. Tule marsh found in Ash Creek Valley. Here tules occurred in virtually monotypic stands

Photo 18. Sedge-rush marsh found in the upper Ash Creek Valley. [illegible] and [illegible] were dominants

Photo 19. Duck nest in *Juncus effusus* (sedge-rush) marsh. These were abundant throughout this vegetation type

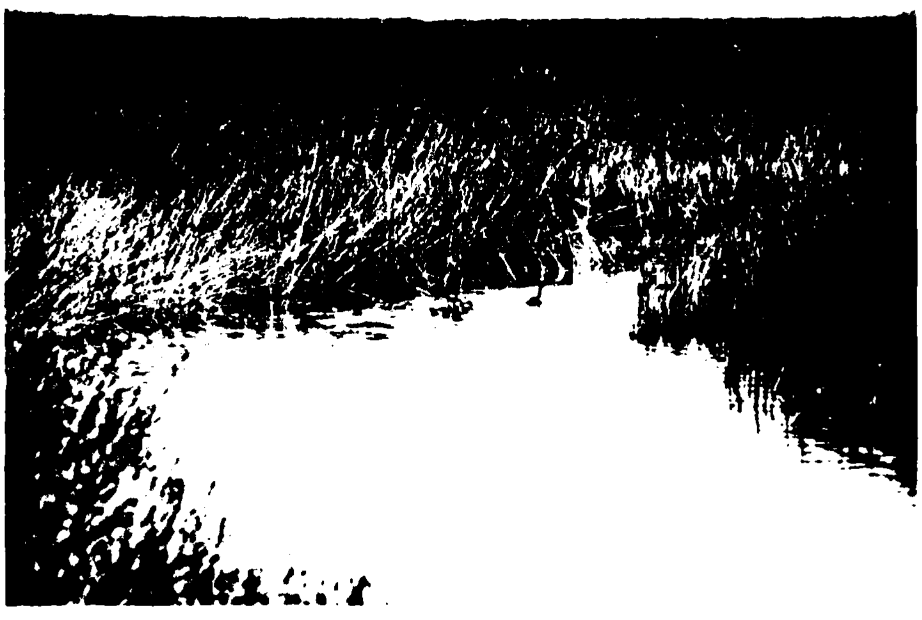

Photo 20. Immature ducks in a small pool within the sedge-rush marsh

Photo 21. Greater sandhill crane feeding in the sedge-rush marsh. The yellow flowered plants in the foreground are *Potentilla gracilis*

Photo 22. Shorebird nest in sedge-rush marsh

Photo 23. Shorebird resting at edge of sedge-rush marsh

Photo 24. Antelope in farm field bordering the wetlands

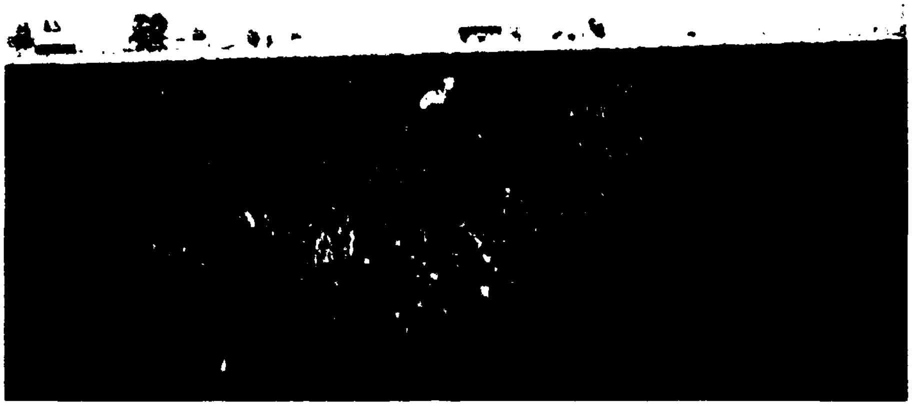

Photo 25. Mule deer feeding in sedge-rush marsh

Photo 26. Channel on east side of property showing streambank erosion

END

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